

INDUSTRIAL MOTOR CONTROLLING USING PLC, HMI SCREEN & WEB PAGE

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Abstract: In recent existences automation is an emerging field in industrial area. In industries the quandary needs to crack as fast as possible as if manufacturing is at a standstill, then the corporation has to face many kinds of losses. In any manufacturing plant, motor plays a vital role. Fabrication of motor uses a conveyer - belt, mixing course, etc. Generally, three phase induction motor is used in any industrial procedure. Controlling the speed of the motor according to the prerequisite is obligatory in any plant. If any delinquent occurs in a process which cannot be tackled by the operator then error should be checked by the programmer. It is not obligatory that programmers should be present at the place. This paper comprises of the proposed system in which whole manufacturing process can be accessed by the programmer from any place. This paper discusses the methods of controlling motor by using Programmable Logic Control (PLC), Human Machine Interface (HMI) screen and Web page. Web page is used for the spontaneous solution of the error. In this paper the method and process of motor using PLC, HMI and Web page is discussed.

Index Terms – Programming Logic Control (PLC), Human Machine Interface (HMI) screen, Motor control, Drive, Automation

I. INTRODUCTION

Mechanization is the procedure in which the diverse control systems and maneuvering organizations are present, such as machinery & processes in numerous industries are used for minimal or reduced human intervention in the production process. This paper deals with Programmable Logic Control (PLC), Human Machine Interface (HMI) & DRIVES for designing whole process according to inevitability.

Drives panels the speed and directions of motor according to obligation. It also panels the frequencies for governing motors. Human Machine Interface (HMI) communicates with the help of Programmable Logic Control. PLC programming is done with the help of Total Integrated Automation (TIA) portal which is a software of Siemens for doing the programming in PLC, and then can control the motor speed and direction using HMI. Increase or decrease in speed of the motor can be achieved by using a slider in HMI or directly entering the rate of Rotation per Minute (RPM).

Programmable Logic Control (PLC) is the device which is utilized in industries for governing multiple processes. It has inbuilt timers, mathematical operations, and so on. From this kind of instruction set we, control of multiple processes is possible. Before the PLC was introduced, there were hard wired logic used in which relay played a vital role. Relay is also called as Relay logic. Relays work by utilizing a coil that is when energized, creates a magnetic power to effectually draw in a switch to the on or off status. When the relay is de-energized, the switch releases and gives back the device to its standard on or off status. In relay logic, relays are power consuming device, then PLC. Relay Logic is the tough to realize compared with PLC logic. In PLC the whole process can be vitalize. The feedback can be attained immediately if there is any fault.

Human Machine Interface (HMI) is the device through which communication with machines or our input and output devices is easy. For communication of HMI to mechanical device, PLC programming is desired. HMI is used in different manufacturing plants for healthier understanding of processing unit. We can easily comprehend the whole process using HMI. In HMI we need to set up the whole process by using TIA portal. For getting the right process through HMI needs to program that using TIA portal and link it to the PLC.

TIA portal is the programming software which is proprietary of Siemens. By using TIA portal the programming of PLC, realization of HMI and connection with web page is conceivable. It is user friendly software. It offers us some languages for programming, which are Ladder (LAD), Functional Block Diagram (FBD), Structured Control Language (SCL), Statement List (STL), and Sequential Function Chart (SFC).

The web page is a hypertext document or cluster of documents which is allied to the World Wide Web (WWW). Web pages are allied to the www so can easily access the anticipated web page from anywhere in the world. The aim of using web page is the utmost advantage of the prevailing technology for governing or indicating the whole scheme from anywhere in the world. If the web page is used for diagnosis in the whole process so no need to be present in the production line for the entire period. The whole process can be controlled from the Web page. There are two methods to connect the system to the web page which are, Static Internet Protocol (S-IP), Dynamic Internet Protocol (D-IP)

The Static IP configuration in the PLC is assigned the permanent IP number. Through this IP number anyone can easily access the PLC by just searching the IP address in a web page which is assigned by the Internet Service Provider (ISP).

The Dynamic IP configuration is only offering the access of the PLC when the PLC and the device from which web page is going to be used are in same Network. So the Dynamic IP configuration if used when the production line is tied in one Network.

II. SYSTEM FLOW

The elementary block diagram is shown in figure1. In this block diagram all parameters are shown through which motor can be control.

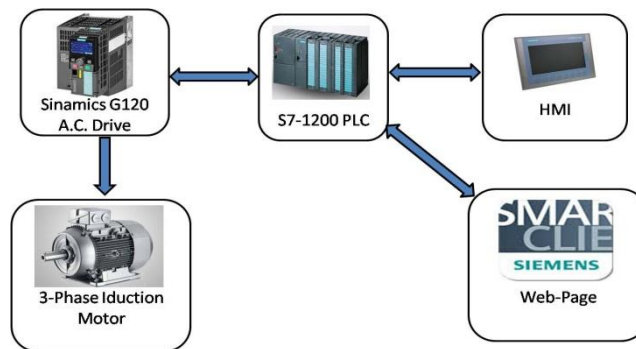


Figure 1 Rudimentary model of System Flow

Block labeled as S7-1200 PLC defines the number and series of PLC which may use. HMI is utilized for examining the speed and direction of a motor by altering some parameters which is projected by using a PLC. It is possible to epitomize some of the apparatuses to represent in HMI graphically. In HMI different parameters of production plant can check. Through HMI the process of production plant is detected and controlled. In proposing system the use of HMI is to monitor and govern the direction of the motor. Sinamics G120 A.C. Drive is used for directing the motor according to the variations made in HMI and or in Webpage. The Web page is the parameter through which, can access PLC from the same network or from different networks. The 3-Phase Induction Motor block is representing the motor, which is used in the industries and which is going to control according to the need.

III. WORKING

The proposed layout and assembly of the system is shown in figure1. All main parameters are included which are used in the proposed system. The main parameters are PLC, HMI, Drive, and Webpage.

A. PLC:

The full form of PLC is Programmable Logic Control.[1] PLC is used in industries for different purposes, like for controlling the manufacturing assembly lines, robotic devices or for any bustle which require high reliability control and easy programming and process. The PLC can divide into three parts (a) Input/output (I/O) module (b) Central Processing Unit (CPU) (c) programming device. Here the number of I/O ports is extendable according to the prerequisite of the process.

For programming of SIEMENS PLC, the software called TIA portal is mandatory. In this software there is possibility for programming language. The option to specify programming language is making programming easy for the programmer. The utmost used programming language in this software is ladder language.

Ladder language programming is a graphical programming language, in which different objects are provided. In this software the mathematical operations and timers and counters are also provided. Programming of a PLC through this software is easy. Firstly, it is obligatory to elect the type of PLC and HMI and give them the appropriate IP address before starting the programming. This is shown in figure 2

Substantially the connection of PLC to HMI is based on Process Field Bus (Profibus) or Process Field Network (Profinet). Mostly the Profinet protocol is used for data transmission. Data transfer speed is higher in this connection so the transmission time is very less equated to any processor or controller. This is one of the main motives to use PLC in industries rather than any microprocessor Board.



Figure 2 Programmable Logic Control (PLC)

B. HMI:

Human Machine Interface is a transducer through which human can communicate with the machine or vice versa.[2] In simple words HMI is a screen through which the observation and controlling can take place. In any manufacturing line there are several HMIs are present for monitoring purpose. If there is any delinquent or error occurs in line, then the operator can regulate the process by using the HMI. If the problem cannot be tackled by the operator it should be checked by the programmer. Programmer can see some readings on HMI and make some essential deviations through HMI to solve the problem.

HMI needs to attach to the PLC for any action taken using HMI. Through TIA portal the communication between the PLC and HMI according to the requirement of the consumer is done. They are available in different sizes. Mostly it is used for making all the readings or parameters of PLC and Drive visible. For example, there is a process in which the RPM and torque of motor need measure. To visually measure the parameters HMI is used. In HMI the parameter is shown in different visual bases in bar form in bar form the level of bar is changing according to the original parameter. Suppose in this example the speed of motor need to alter according to the demand of the process so in HMI there are several options like push buttons, knob, etc. are present for increasing or decreasing the parameter.



Figure 3 Image of developed Human Machine Interface (HMI)

C. Drive:

Drives are used in the complete industrial areas, machinery, construction sectors, automobile industries, textile plants, printing of newspaper, packaging of different type of products, and as well as in conveyor technology.[3] Rather than that, using drive Sinamics G120 is virtuous because, in this drive there is freely selectable combination of Power Module (PM) and Control Unit (CU) are accessible. If there is any problem in PM and CU they can be individually replaced. In the Sinamics G120 drive the CU version is integrated with safety function which is Safe Torque Off (STO).



Figure 4 Image of Sinamics G120 Drive

Sinamics G120 drive has some benefits over the other regular drive. One of them is, it is resumed after the main power is failed. The drives are using STARTER for smooth commissioned. STARTER can commission using the Wizards and graphic screen. The type of power module which is used in this drive is PM250. The number of digital Input and Output (I/O) ports is 4. And Analog I/O is 2.

D. Web Page:

The Web page is familiar to any person in technological era.[4] In the proposed system the web page is used for monitoring and controlling the production process from any device. When a web page is used, then it is not mandatory to use dedicated computer system. By using the web page, the owner and the programmer can access the system from anywhere and from any device. The proprietor of the production plant or industry can easily get the number of production by using the web page.

In this paper, PLC and drive are used is of SIEMENS so the application is used is of SIEMENS which is server client application of SIEMENS through which authorized person can access all PLC and Drives which are connected to this web page. This phenomenon is mostly similar to the IoT. But in this web page system, there are some restrictions of using it as IoT. The PLC can connect to the web page by using two parameters which are, Static Internet Protocol (S-IP) and Dynamic Internet Protocol (D-IP) .

The Static IP configuration in the PLC is assigned the permanent IP number. Through this IP number anyone can easily access the PLC by just searching the IP address in a web page which is allocated by the Internet Service Provider (ISP).



Figure 5 Smart Client Application of SIEMENS

The Dynamic IP configuration is only offering the access of the PLC when the PLC and the device from which web page is going to be used are in same Network. Hence, the Dynamic IP configuration if used when the production line is tied in one Network.

IV. RESULTS

Here are some of the results of the proposed system. It is obligatory to connect all parts of them virtually as well as physically. The virtual connection means connect them in TIA portal which is the programming software for SIEMENS PLC as well as drive and HMI. The virtual connection of the all devices is shown in figure 6. Physical connection means the all devices need to fix through Profinet or Profibus parameter. In simple words, link all devices through Ethernet cable and/or using Profibus cable.

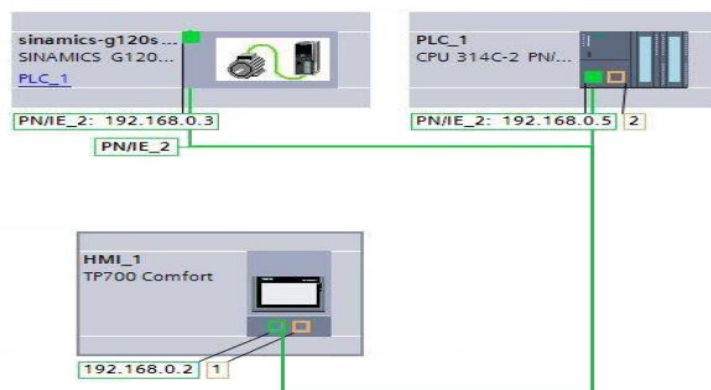


Figure 6 Virtual Connection

Now when all connections, virtual as well as physical is ended, then the programming of PLC is going to be perform. The motor is controlled by drive. Here proposed drive is Sinamics G120 which is the universal drive.

By using g120 drive the speed of motor is controlled by varying the frequency. PWM (Pulse Width Modulation) is the method through which the frequency is altered and the motor is controlled. When the frequency of PWM is altered, the voltage and current ratio is also transformed. And RPM of the motor is controlled by fluctuating parameters like voltage and current. Here are some of the measurements of different parameters according to the set torque using the drive.

Table 1 HMI parameters

Sr. No	Set Speed (RPM)	Actual Current (A)	Actual Torque	Voltage(AC 3-Phase)
1	0	0	0	0
2	420	0.51	0.45	110
3	750	0.52	0.38	197
4	930	0.55	0.36	245
5	1500	0.60	0.9	415

The designed HMI screen for the testing purpose is shown in figure 7. In HMI screen, there are several objects are present like push buttons, bar, push switch.

On this HMI screen, when the cycle start button is pressed once the process cycle is started. As main aim is to start the motor quickly and another is to control and monitor the process from the any device. Here through HMI screen motor can control and monitor appropriately. If in case of fault, the bars of motor parameters are transformed rapidly. If the operator wants to modify the direction it is probable. Because there are two push buttons in HMI screen named forward and reverse, by clicking this button operator can alter the direction of the motor. Now for certain process the speed of motor need to increase or decrease the operator can also do that by pressing buttons named INC and DEC. By pressing INC button, the speed of the motor is increased and by pressing the DEC named button the speed of the motor is decreased.

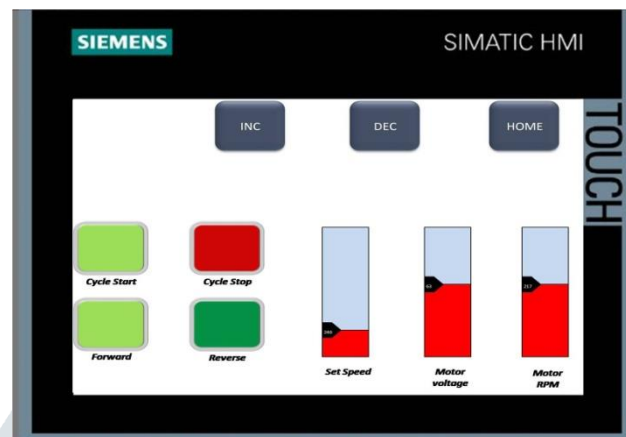


Figure 7 HMI Screen

V. CONCLUSION

In this paper the proposed system was observed in which whole manufacturing process can be accessed by the programmer or the owner from any place. The methods of controlling motor by using Programmable Logic Control (PLC), Human Machine Interface (HMI) screen and Web page were observed. The web page is used for the spontaneous solution of the error from anywhere. It was seen that the motor was not started with the jerk.

VI. REFERENCE

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