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Review Of Control Of Induction Motor Using PLC S7-1200

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Abstract: Induction motor (IM) energy efficiency is critical in the contemporary environment for reasons like cost savings and energy conservation. This paper completes the implementation of the induction motor's safe speed regulation. When a speed is exceeded, the motor is tripped by the Programmable Logic Controller (PLC) in accordance with safety regulations. Three phase IM is controlled by a PLC using a Variable Frequency Drive (VFD) Software and drive data accessibility facilitate information processing, manipulation, and analysis. Within the field of Electrical Engineering, one of the primary areas of interest is the control of Induction Motors (IMs) by use of sophisticated technologies, such as the Programmable Logic Controller (PLC) S7-1200 PLCs—more especially, the Siemens S7-1200 model—provide an accurate and effective way to control IMs in industrial environments. Organisations can improve the efficiency, dependability, and performance of their motor control systems by utilising PLCs. the application of Programmable Logic Controller (PLC) S7-1200 for the safe speed regulation of induction motors. The study highlights the financial advantages of energy conservation as well as the significance of energy efficiency in the current environment. The goal of the project is to effectively monitor and operate three-phase induction motors using PLCs and Variable Frequency Drives (VFD).The PLC S7-1200 is one example of an advanced technology that may be integrated to provide precise control over industrial motor systems, improving reliability and performance. The goal of the research is to optimise the use of energy in industries by using novel motor control system techniques.

Keywords: Induction motor (IM), Programmable Logic Controller (PLC) Speed Control, Variable Frequency Drive (VFD), TIA Portal.

I. INTRODUCTION

Advanced technologies, such as the Programmable Logic Controller (PLC) S7-1200, are used in industrial applications to regulate induction motors. Since induction motors are durable, affordable, and dependable, they are frequently used in a variety of industrial processes. PLC integration—specifically, the Siemens S7-1200 model—provides accurate and effective control over induction motors, improving system dependability, performance, and energy efficiency.

The application of PLCs to regulate induction motors has gained a lot of attention in the field of electrical engineering. Adoption of PLCs—particularly Siemens S7-1200 models—allows for the implementation of complex control schemes that make Induction Motor monitoring and operation easier. This simplified method of motor control emphasises how crucial automation and cutting-edge technologies are to the efficiency of industrial processes.

The industry's dedication to raising system performance, cutting operating costs, and increasing energy efficiency is shown in the focus on PLC-based induction motor control. Organisations can get more control and monitoring capabilities over their motor systems by utilising PLCs such as the Siemens S7-1200. This can result in improved productivity and operational excellence in industrial settings. A move towards smarter and more integrated control systems is marked by the introduction of PLCs like the Siemens S7-1200 in motor control applications, opening the door for increased efficacy and efficiency in industrial operations. the importance of applying cutting-edge technology to maximise induction motor control and operation, emphasising the advantages of PLC integration for accurate and effective motor control in industrial applications.

the industrial configuration where a three-phase induction motor's speed is controlled by using the Siemens S7-1200 PLC and the TIA PORTAL software. To guarantee accurate and effective control over the motor system, the PLC must be programmed and configured using the TIA PORTAL software.

The project's incorporation of the TIA PORTAL software represents a move in industrial applications towards sophisticated automation and control technologies. Engineers and technicians can facilitate smooth communication and coordination between the PLC and other motor control system components by optimising the programming and configuration processes of the PLC through the utilisation of TIA PORTAL's capabilities.

II. METHODOLOGY

The block diagram of Induction Motor Speed Control Using PLC and VFD shown in figure 1.

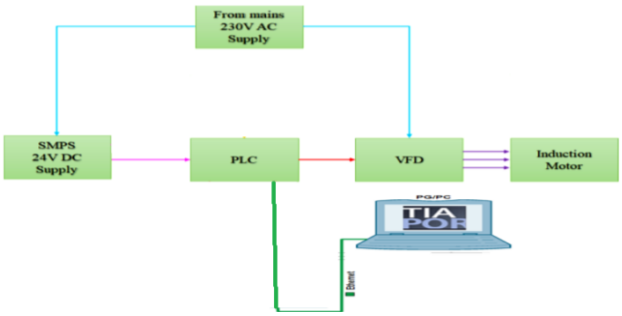

Figure 1. Induction Motor Speed Control Using PLC

The block diagram above shows the speed control mechani sm for a three-phase induction motor. The Power Supply, SMPS, PLC, VFD, and IM make up the suggested system. The VFD and the SMPS receive the 230V AC power from the mains. With the exception of the IM, every piece of equipment has a 24V DC supply. The VFD output powers the induction motor with a 440V AC supply. Siemens S7-1200 1214 DC/DC/DC is the PLC used in the project. It has two analogue inputs (0–10) V, two digital inputs and ten digital outputs, each of which is 24 VDC. The Siemens Sinamics V20 VFD is used to convert a 230 V single phase supply to a 440 V three phase supply. specifications of the utilised equipment.

The application of a TIA PORTAL software-based Programmable Logic Controller (PLC) S7-1200 control system to manage the speed of a three-phase induction motor. The power supply, switched-mode power supply (SMPS), Siemens S7-1200 PLC, variable frequency drive (VFD), and induction motor are among the parts of the system configuration. Together with the VFD, the PLC is in charge of keeping an eye on and managing the induction motor's speed. The PLC is programmed and configured using the TIA PORTAL software to guarantee accurate and effective control over the motor system.

This approach aims to optimize energy efficiency and enhance the performance of the Induction Motor in industrial applications.

Table-I: Specifications of VFD

Power	
Input Voltage	1Φ 230V AC
Output Voltage	3Φ 400V AC
Power Factor	≥0.95/0.72
Supply Frequency	50/60 Hz
Overload Current	150% of rated current
Signal Inputs and Outputs	
Analog input	AI1: Bipolar Current/Voltage AI2: Unipolar Current/Voltage Can be used as digital inputs
Analog output	AO1: 0-20mA
Digital inputs	DI-DI4, optically isolated PNP/NPN selectable by terminal

Table -II: Specification of PLC

Product Description	
Make	Siemens
Model	SIMATIC S7-1200, CPU 1214C,
	DC/DC/DC
Inputs	14 DI: 24V DC 2 AI: 0-10V DC
Outputs	10 DO relay
Supply	85-264V AC
Frequency	47-63 Hz

Outputs	10 DO relay
Supply	85-264V AC
Frequency	47-63 Hz

The main characteristics of the Siemens S7-1200 PLC, such as its frequency range, power supply needs, and input and output capabilities, are highlighted in these specs. The PLC may be used to monitor and control the speed of the three-phase induction motor in the industrial setup because of its relay digital outputs and digital and analogue input possibilities

Table- IV: Specification of Induction Motor

Make	Siemens
Type	3-phase AC induction motor
Voltage	415V AC
Current	1.2A
Power	0.37
Rated Speed	1385 RPM
Frequency	50 Hz

These specifications outline the key parameters of the Induction Motor, including its voltage, current, power rating, speed, and frequency. The motor's characteristics are essential for understanding its performance and compatibility with the control system implemented using the Siemens S7-1200 PLC and Variable Frequency Drive (VFD)

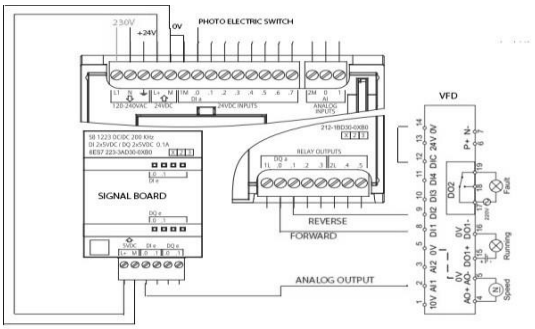

Fig 2. Connection between PLC and VFD

From the figure2, it is observed that the 230VAC supply is given to the PLC from the SMPS. The output of the photoelectric switch is given to the pin I0.0, and the output from PLC Q0.0 is given to pin DI 1 of the VFD and the output Q0.1 is given to DI 2 of the VFD. The analog output from the VFD A0 is given to AI 1 of the VFD.

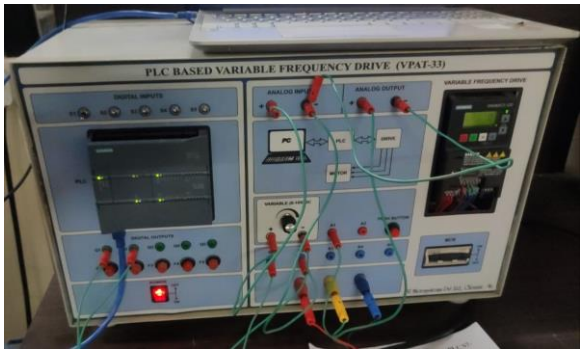

Fig 3. Hardware Setup for Induction Motor speed control using PLC and VFD

The following parts and connections are involved in the setup:
Power deliver: To deliver electricity to the parts used in the control setup, the system has a power supply.
Siemens S7-1200 PLC: The Siemens S7-1200 PLC, in particular, is the central control unit that keeps track of and adjusts the speed of the induction motor. For control and communication, it is linked to a number of input and output devices.
variable Frequency Drive (VFD): This device is necessary to drive the induction motor at varied speeds. It does this by converting a single-phase 230V AC supply into a three-phase 400-volt AC supply.
Induction Motor: A 3-phase AC induction motor with precise specs for voltage, current, power rating, speed, and frequency is part of the configuration.
For speed control, the motor and VFD are linked.
Connections: Using the proper wiring and communication protocols, the PLC, VFD, and other components are connected as part of the hardware setup. The PLC, VFD, and Induction Motor can communicate and send control signals more easily thanks to the way inputs and outputs are set up.
The hardware configuration's integration of various parts and connections permits accurate and effective management of the speed of the induction motor in an industrial setting, highlighting the significance of automation and cutting-edge technology in maximising industrial operations.

Table-V: Performance of IM with VFD

S. No	Frequency (Hz)	Analog Output Voltage from PLC (VDC)	3-phase output Voltage from VFD (VAC)	Speed of the Motor (RPM)
1	0	0	28	0
2	2	0.39	59	58.4
3	4	0.79	76	118
4	5	0.99	89	150
5	8	1.58	110	240
6	10	1.98	123	300
7	15	2.97	163	450
8	20	3.97	195	600
9	25	4.96	234	754
10	30	5.95	244	923
11	35	6.95	245	1056
12	40	7.94	246	1204
13	45	8.93	246	1362
14	50	9.93	246	1502

The preceding table shows that the PLC's output analogue voltage grows linearly with an increase in the input frequency. The VFD analogue input channel receives the analogue output. As a result, as the analogue voltage rises, the motor receives a higher 3-phase line-to-line output voltage. The motor's speed increases as the three-phase voltage rises.

V. CONCLUSION

This paper presents the design of a VFD hardware system that adjusts the motor speed by varying the output frequency. In the end, it is determined that, when a PLC is used to operate the variable frequency drive (VFD), this is the most efficient and effective way to manage the speed of a three-phase induction motor. The entire system operates at the highest possible level of safety, accuracy, and capability. A programmable logic controller (PLC) system, like the one presented in this work, can be used to monitor and control various motor parameters in addition to speed control. This means that a single drive can be used to operate numerous motors. highlights how important it is to use cutting-edge technologies for managing the speed of a three-phase induction motor in industrial applications, such as the Siemens S7-1200 PLC and the TIA PORTAL software. The project seeks to obtain accurate and effective control over the Induction Motor system by utilising the Siemens S7-1200 PLC and the capabilities of the TIA PORTAL software. The Variable Frequency Drive (VFD), along with other system components, work in tandem with the PLC, which acts as the central control unit, to monitor and control the motor's speed.
Rather, the emphasis on controlling using the PLC and software draws attention to how dependable and effective the automated control system is. By integrating cutting-edge technology, the induction motor can operate and be monitored with ease, improving system performance and energy efficiency in industrial processes.
In summary, the project shows how well the Siemens S7-1200 PLC and the TIA PORTAL software work together to regulate an induction motor's speed in three phases. The simplified method of motor control emphasises how crucial automation and cutting-edge technologies are to maximising industrial operations,
improved efficiency, reliability, and performance of the motor system.

REFERENCES

I. Energy conservation using variable frequency drive in pumping application, Ankur P. Desai, Rakesh J. Motiyani, and Ajitsinh R. Chudasama, Proceedings of International Journal of Engineering Development and Research, 2014, pp.121–126.

II. Design and implementation of a PLC-based monitoring control system for three-phase induction motors fed by a PWM inverter was done by Birbir, Y., and H.S. Nogay. 2008; 2(3): pp. 128–135, International Journal of Systems Applications, Engineering & Development

III. Gupta, V., Induction Motor Speed Control Using PLC AND SCADA. International Research Journal of Engineering and Technology, 2018. Vol. 05 no. 03.

IV. Speed Control of Three Phase Induction Motor Using PLC under Open and Closed Loop Conditions, KM, M.K. and B. Ramachandra. 2017. Vol. 07, no. 01, pages 34–39, International Journal of Engineering Research and Applications.

V. The International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 3, Special Issue 4, pp. 12-19, features an article by R. CharletPriya titled "Variable Frequency Drive Induction Motor in Air Conditioner Using Seven-Level Inverter."