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Speed Control of Induction Motor using Variable Frequency Drives and PLC

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ABSTRACTS: In any industry the induction motor play an important role due to its low cost and simplicity. In existing system motor speed is monitor by HMI (Human machine interface). This paper suggests the use of PLC and VFD combination to control the speed of a 3 phase induction motor. The combination of PLC and VFD provides an efficient approach for getting a motor with continuous running. It is cost effective method along with huge amount of energy saving. By this method the variable frequency is set by VFD and speed can be change as per requirement. The entire control system is switch by PLC. Therefore the main contribution of this paper is monitoring, controlling of speed of induction motor by using PLC.

KEYWORDS:- Load (Motor), PLC (Programmable Logic Control), VFD (Variable Frequency Drive), speed reference control.

I. INTRODUCTION

I. Variable Frequency Drive

Variable frequency drive is basically used where the variable speed is essential. It is a device in electrical system which performs the conversion of single phase or three phase supply of Fix frequency into three phase supply with variable frequency. It is used for the application of variable speed requirement .Due to smooth operation it has widely used in the application of speeds control of motor. It can be controlled either manually or automatically. In over application it is controlled automatically by using PLC. It helps the operator to vary the speed of motor automatically. The operation is carried out by using PLC (Programmable Logic Controller). Reversing, switching and braking are additional function performed by VFD. For connecting switches and push buttons different I/O's terminals are given. A port for serial communications is also provided which allow VFD to be controlled and monitored by computer.

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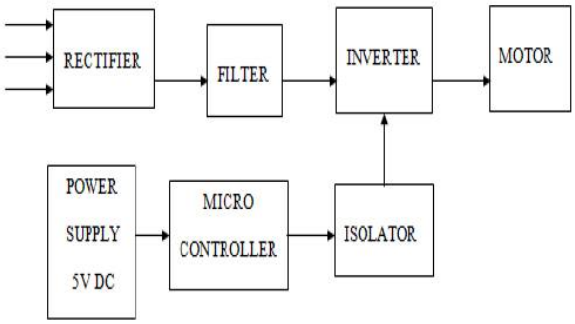

Fig 1: VFD block diagram

II. PLC (PROGRAMMABLE LOGIC CONTROLLER)

It is used in electrical system to improve the reliability and efficiency of electrical equipment (electrical motor) in automation processes. To obtain accurate result PLC is interfaced with converter, PC (Personal computer) and other electrical equipment. In this application PLC of Allen Bradley is used to communicate with VFD and in turn it control 3 phase induction motor. A control program is developed to get required operation of motor and VFD.

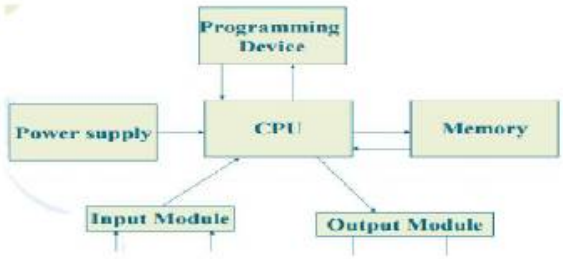

Fig 2: PLC block diagram

Advantages of PLC
Reduced space
Energy saving
Ease of maintenance
Economical

III. PROPOSED SYSTEM

Proposed system block diagram shown in Fig.3 and it consists of two power supplies, one is 230V and other is 440V.The 230V supply from main is converted into 24V DC and it is given to the PLC unit. The second supply from main 440V is directly given to the VFD. The PLC (Programmable Logic Controller)unit in the block diagram is used to control the VFD and through the VFD the motor is controlled.

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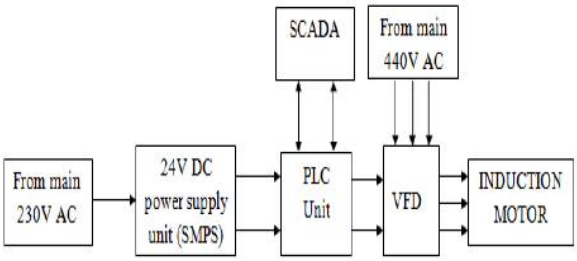

Fig 3: Block diagram of overall system

PLC has memory for storing the user program or logic as well as a memory for controlling the operation of a process machine or driven equipment. The PLC is programmed in LADDER LOGIC (A high level, real world, graphic language that is easily understood by engineers).The speed of the motor is controlled by varying the frequency through Pulse width modulation controller. The variable frequency is set by using VFD. The VFD is connected with motor. By changing the output frequency the motor speed can be varied.

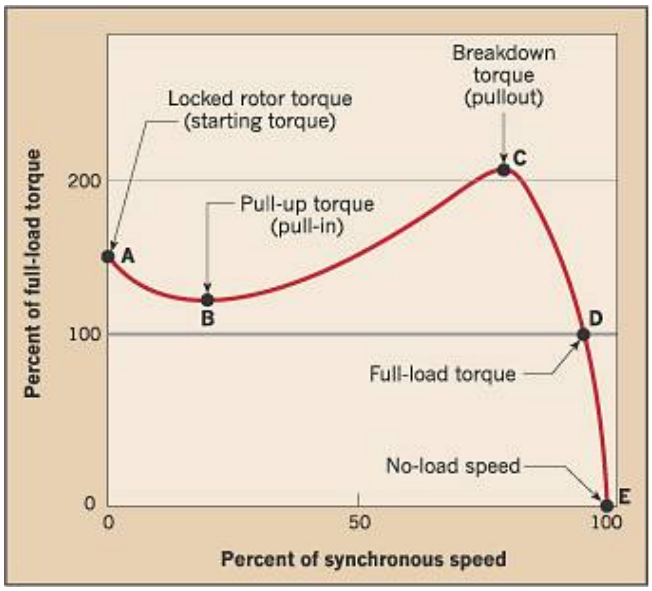

Figure 4: Torque speed characteristics of induction motor

As induction motor follow the relation
T α V/F
So for constant v/f ration a constant torque can be achieved. However, this control scheme focus to ensure that any particular torque can be obtained at the same flux as operating at normal frequency and voltage.
Ns = 120f/p
From above relation the induction motor speed can be changed by varying the frequency of supply given because poles are inbuilt and cannot contribute in speed control. So for constant v/f ratio torque developed is constant in entire operation. It is the only focus of this method. Fig.5 shows the speed-torque characteristics of the IM with VF control.

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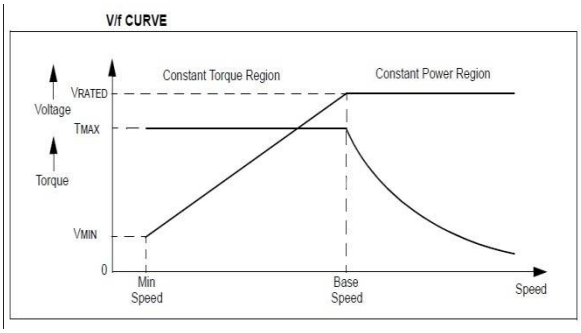

Figure 5: Torque speed characteristics with v/f control

Conduction of Experiments Allen-Bradley PLC, Allen-Bradley Power Flex 4M Variable Frequency Drive, a three-phase induction motor driving a conveyor belt load controlled by ladder logic software and In touch 9.5 software was connected for the conduction of the experiment in which for various values of input supply frequencies, the corresponding values of motor speed in rpm were obtained as shown in Table 3.

Input supply frequency in Hz	Motor speed in rpm
0	0
5	250
10	620
15	940
20	1240
25	1495
30	1809
35	2100
40	2350
45	2590
50	2800
55	3200
60	3450

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HARDWARE MODEL:-

Fig 6: Hardware Model

The Fig.6 shows overall hardware model of this project. Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of load is called a power supply unit or PSU. To control the speed of induction motor, a motor drive and control system with different methods can be used. The three phase induction motor is, by a very considerable margin, the most widely used AC motor in industries. The reasons are its low cost, simple and rugged construction, absence of commutator, good speed regulation. An induction motor of a medium size may have efficiency as high as 90% and a power factor of 0.89.

VII. CONCLUSIONS

In this project, the design of VFD hardware system for changing the speed of the motor by changing the output frequency is presented. Finally it is concluded that the method of speed control of three phase induction motor using variable frequency drive is the effective and efficient method. When the operation of VFD is control by PLC. The whole system gives the operation to a level of accuracy, ability and totally with maximum safety. It is possible that, the speed control system can be implemented to control multiple motors with the same drive and programmable logic controller, the PLC system which is used in this paper also used for monitoring and controlling the other parameter of the motor with the same drive.

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