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RESEARCH ARTICLE

CONTROLING SPEED OF INDUCTION MOTOR BY USING VARIABLE FREQUENCY DRIVES WITH PLC: A REVIEW

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ABSTRACT

In this Paper we have studied the PLC and VFD, its operation which can be used along with the Induction Motor and can control the parameters of it for Automation in industries. The overall scheme and system of implementing V/f control has been presented. One of the basic requirements of this scheme is the PWM Inverter system. In this, PWM Inverters have been modelled and their outputs are fed to the Induction Motor drives system. The uncontrolled singl like transient and steady state response of the Induction Motor has been obtained and analyzed. The speed of the motor is controlled by varying the frequency through triggering the VFD i.e. PWM technique. Thus it causes the output voltage of the VFD according to its turn on time i.e switching time. The inverter converts DC power to AC power at the required frequency and define amplitude. By this the variable frequency is set by VFD and the motor speed can be changed to the required speed. The entire control system is switched by using PLC system. Thus the main Aim of this paper is the monitoring, operating speed control of motor based on VFD and programmable logic controller, and SCADA system is also developed which shows the parameters of IM on the GUI Application based Software.

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INTRODUCTION

Induction motors are used in many industrial applications in a wide range of operating areas as they have simple and robust structure. The production cost is also low. The advantages of Induction motor are,

- It has good self-starting capability.
- Its construction is very rugged and is reliable.
- It has easy maintenance and low cost.

Thus induction motor is widely used in the in industrial, commercial, aerospace and military applications.

As the Speed of Induction Motor is given by the formula,

$$Ns = (120*F) \div P \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,
Ns = the synchronous speed of the stator magnetic field in RPM
P = the number of poles on the stator
F = the supply frequency in Hertz

From (1), the specific speed of the induction motor is directly proportional to the supply frequency and is inversely proportional to the number of poles of the motor. As the no. of poles are constant by design itself, thus the speed of induction motor is varied with the supply frequency. Thus Speed control of a 3-phase induction can be achieved using VF control. The speed control of induction motor is achieved from the various parameter tests performed and its protection is done by its different parts of software and hardware implementation. The use of inverter for tests on induction motor by the control of PLC provides good accuracy and speed regulation comparing the conventional V/F control method. The induction motor used along with the PLC for automation in industries provides better efficiency (Maria, 2004). The test performed on the induction motor fed by a VFD shows the effect on voltage stability and power drawn from the grid. The voltage drop is reduced and the power transfer capability increases as compared to induction motor alone (Leon Max Vargas, 2008). The speed control of three phase motors along with the VFD with help of varying currents, provides a better controlling for the operation of air handling units which leads to the energy saving. Thus leads to saving of operational cost of the system (Karl Braun *et al.,* 2016).

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The control of induction motor by VFD and PLC for the compacting machine unit is done and monitored. The PLC controls all the operation of the machine using ladder logic and thus its increases the efficiency operated at varying speeds leading to the automation (Sowmiya). The induction motor analysis is being done to safeguard the system from error condition. The speed control has achieved using PLC, converter and the encoder. A SCADA system has been developed to monitor the parameters.

It provides the cost efficiency of the system (Ayman Seksak Elsaid *et al.,* 2016). The analysis on the performance of induction motor is done with its characteristics. A linear curve parameter is obtained on the graph plotted between motor frequency and speed. The control system using PLC and SCADA proves a reliable operation and efficient leading to safeguard from the fault and error condition (Pradip *et al.,* 2016). The combination of PLC and VFD provides an efficient way to control the speed of three phase of induction motor which provides the continuous running operation. The mechanical stress on the IM gets reduced due to VFD technique on system. It is consult with cost efficient and energy saving technique. It provides the voltage stability and reliability to the system leading to the greater life of the machine (Bishnu Prasad Satpathy *et al.,*). The operating speed of a motor connected to a VFD is varied by changing its frequency of the motor supply voltage. This allows continuous process speed control. Provides control as per load condition and load requirement and thus leads to energy saving and gives better results.

Programmable logic controller

The Programmable logic Controller is a system based specialized microprocessor based computer operated system for controlling the machines in the particular system and processes in industries. Control system engineering plays an vital role in automation industry and controlling application in industrial area. In early decades the electric machine control was done by using particular relays which in today leads by the PLC system. The basic block diagram of PLC operated system is illustrated in the figure 1.

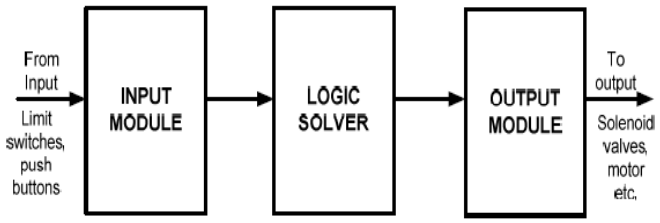


Figure 1. PLC Basic Block Diagram (Sowmiya)

The Programmable logic controller (PLC) can be used for smart monitoring operation and controlling of various electric based drives in industries. It stores instructions in programmable memory in the system and performs the various functions as per requirements.

- Fast Logical operation.
- Sequencing, timing and counting.
- Arithmetical operations.

It is nothing but a Solid state device, which Switches output based on input status and user defined program. It constitutes as a Main component of automation industry and is able to sustain in harsh environment of surrounding Industries. Ladder programming for the controlling of the load can be done according to our wish and requirement i.e. to ON/OFF the load automatically.

Variable frequency drive

A variable-frequency drive (VFD) also called as adjustable-frequency drive. It is also called as variable speed driving system. it is the AC drive also known as asynchronous driving system. A micro drive or inverter drive is a type of adjustable-speed drive used in particular electro-mechanical drive systems to control AC motor speed by varying motor input frequency and voltage. VFD is a system made up of active and passive components of power electronics devices, high speed central controlling unit & sensing devices. The basic function of VFD is to act and operate as a variable frequency generator in order to vary speed of motor as per the user setting. Variable Frequency Drive (VFD) can be used to control the speed of three-phase induction motor. A variable frequency is a drive system equipped for the application of controlling the rotational speed of an alternating current (AC) electric motor by controlling the frequency of the electrical power supplied to the motor.

The three basic components of the VFD are:

- Rectifier
- DC Bus/DC link
- Inverter system

The basic block diagram of VFD is shown Fig 2.

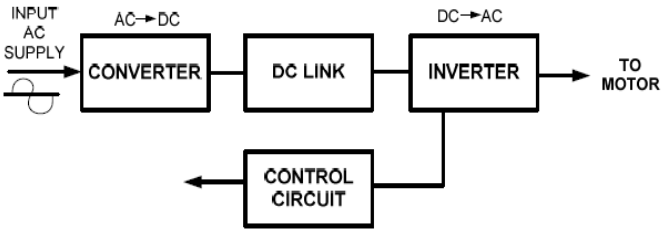
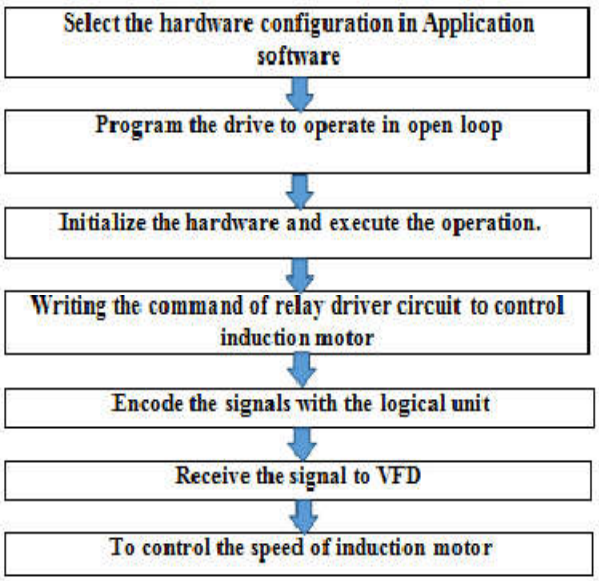


Figure 2. VFD basic Block diagram

Proposed work

The intent of the project is to controlling and monitor the Variable Frequency of operating Drive. The aim of the project deals with the development in the VFD system so as to control the various system parameters of VFD which is directly connected to IM with saving of energy. In order to do so, a VFD (Variable Frequency Drive) is attached to the Induction motor and can be used for various applications purpose. The PLC operates and switches on the variable frequency drive, which in turn drives the motor with desired speed by varying the frequency & also give protection to induction motors against possible failures by increasing the reliability and combination of two i.e. PLC and VFD method is proposed which help is an efficient approach used for getting continuous running of the induction motor Reduced Space, Energy saving, Greater life and improve reliability**.**

Project overview



METHODOLOGY

This Project proposed to "CONTROLING SPEED OF INDUCTION MOTOR BY USING VARIABLE FREQUENCY DRIVES WITH PLC" using various techniques. This paper is based on studying and operation of PLC and VFD for IM control system. The VFD system which drives the motor which is controlled via PLC checking statues and operation of the motor considering various parameters which is communicated via serial communication (RS232 channel) with the monitoring i.e. the type of supervision software. The existing VFD's uses the PWM techniques for the load control and thus causes the presence harmonics and noise in switching angle. This project deals with the use of diode clamping VFD with flying capacitors for conversion of single phase supply to three phase of supply which connected to VFD with load. The VFD communicates with the switching mechanism which is communicated to the logical unit system of PLC which sends signals at different switching angles with the help of communication protocol in supervision software. The supervision software proposed to the ladder and GUI.

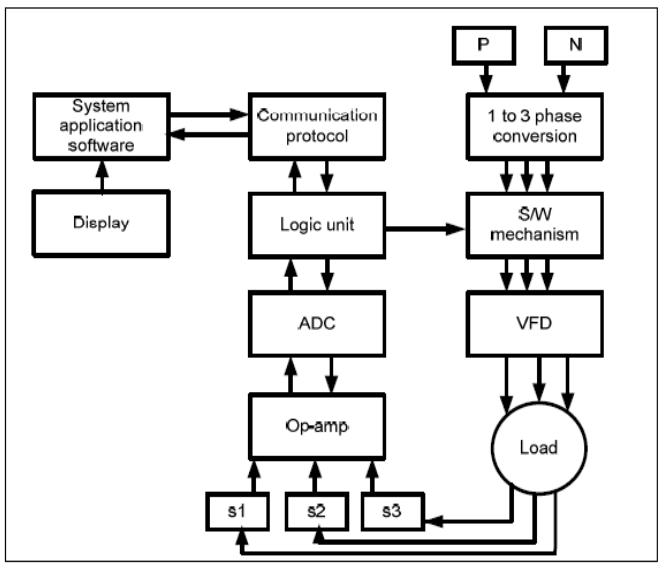


Figure 3. Block Diagram of Proposed Scheme

The ladder diagram which executes the hardware architecture for the flow of data for controling and monitoring parameters. The data is being extracted by using Bayesian classification algorithm for the probability of healthy equipment in system of GUI parameters. The Block Diagram of the system is being shown in Fig 3.

Where in,

P= Phase connection related to the single phase supply.
N= Neutral connection related to the single phase supply.
S1, S2, S3= Current, Temperature and speed sensors for monitoring IM. The processing unit performs task for analog sensors which converted to digital form, processing of data for system supervision in the monitoring window. The health parameters of load i.e. the sensors connected to it for measurement of current, temperature and speed providing the healthy and unhealthy data in the system.

The switching mechanism performs the switching phenomenon in VFD by triggering the mosfet at different angles at different stage for various speeds by varying input frequency. The switching mechanism consist of the electromechanical relays (STDP) connected to the mosfet so it than generates the gate pulse at different angles at different stage and performs the analog triggering of relay whereas communication protocol performing the operation in IEEE std. (RS232) communicated to supervision software for monitoring and observation.

Three phase induction motor

Characteristics

- Induction motors are the most common type motors used for various purpose and various equipment in the industry.
- Their popularity is due to their simplest design, they are inexpensive and easy to maintain.
- This is also used in for controling variable speed drive applications.
- This machine is economical, rugged & reliable and is available in range of MW capacity.
- Less cost and Maintenance.
- It can be directly connected to an AC power source.
  An induction motor has two main electrical components
- Rotor part (Squirrel-cage rotor and Wound rotor)
- Stator part.

Specifications

Rated Power in (KW)/(HP)	0.76/1
Rated Voltage in (volts)	425
Rated Current in (ampere)	2.0
Rated Speed in (rpm)	1480
Rated Frequency in (Hz)	50
Power Factor	0.85
Efficiency (%)	77

Conclusion

Today's modern type of world seeks a renewable energy source for the and monitoring electricity requirement and thus concept of power management can be achieved by controlling speed of 3-phase induction motors which leads to a large Saving of power. This project proposed to variable frequency drive system with help of logical units i.e. PLC logic circuit.

The logical unit well performs the various operations for health parameter and controls using window based application software and monitors the parameter on window system. This paper is basically based on studying the PLC and VFD for IM control in respect with ongoing project so, the parameters and results are yet to generate. So in future prospects this can be proved an efficient technique in industries leading to control and automation techniques to suffice the needs through variable speed operation for various purpose of induction motor leading to high energy saving.

REFERENCES

Ayman Seksak Elsaid, Wael A. Mohamed, Salah Ghazy Ramadan Ayman Seksak Elsaid, Wael A. Mohamed, Salah Ghazy Ramadan, "Speed Control of Induction Motor Using PLC and SCADA System," *Int. Journal of Engineering Research and Applications*, Vol. 6, Issue 1, (Part - 4) January 2016, pp.98-104.

Bishnu Prasad Satpathy, Dinesh Kumar, Manish, Manoj Kumar Bhargard, S. S. Hirve, "Speed Control of Three Phase Induction motor by Using PLC and VFD", Dept. of EEE, Bharati Vidyapeeth Deemed University College of Engineering, Pune. Transactions on Engineering and Science, Volume 4, Issue 2.

Karl Braun, Evan Eaves, Christopher Giambri, Dylan Chapman, Hunter Heavner, John Woodward, Jacquelyn Nagel and Kyle Gipson, "Reducing Electrical Energy Consumption of AHU Fans Through the Integration of Variable Frequency Drives," IEEE Systems and Information Engineering Design Conference, 2016.

Leon Max Vargas, Student Member, IEEE, Juri Jatskevich, Senior Member, IEEE, and Jos R. Martí, Fellow, IEEE, "Load Modeling of an Induction Motor Operated with a Variable Frequency Drive," 2008 IEEE Electrical Power & Energy Conference.

Maria G. Ioannides, Senior Member, IEEE, "Design and Implementation of PLC-Based Monitoring Control System for Induction Motor," IEEE Transactions on Energy Conversion, Vol. 19, No. 3, September 2004.

Pradip M. Ambore, Prof. M. S. Badmera," PLC & SCADA based Condition Monitoring of Three Phase Induction Motor", Dept. of ECE, D.I.E.M.S., Aurangabad, Maharashtra, India. Vol. 4, Issue 6, June 2016.

Sowmiya, D. "Monitoring and Control of PLC based VFD fed Three Phase Induction Motor for Powder Compacting Press machine." Department of EEE, Sri Shakti institute of Engineering and Technology, Coimbatore, India.

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