

# Integration of SCADA System with Existing PLC Setup to Control Induction Motor and Stepper Motor

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**Abstract:** Automation is the process with the minimum human error. It is inspired by word automatic. The use of machines instead of human effort and the whole process is observed and controlled by software and hardware. Automation is widely used in industries, manufacturing etc. This paper shows automation in electrical field. With the help of PLC and SCADA, we will control the speed of induction motor and Stepper motor. A PLC SCADA monitoring is provided to control speed. To reduce the cost, error provided by human interaction is avoided by using PLC SCADA system. It can be used for induction drive, frequency controlled technique. Aim of this method is remove all disadvantage caused by traditional ways and make more perfect.

**Keywords:** PLC, SCADA, Automation, HMI.

## 1. Introduction

Automation plays vital role in industries, manufacturing, process, development sector. automation requires no human involvement. It is step which is more ahead than mechanization. Automation increases productivity. It reduces its cost. It gives flexibility to process. It increases quality in process. There is no involvement of human. Automation can perform the tasks beyond the human capabilities like speed, size, weight etc. Automation can also involve in speed control of induction motor and stepper motor by using PLC AND SCADA system. Induction motor is used in every small and large scale industries because it is simple and rugged in construction [7]. It can operate in any environmental condition. It is cheaper in cost. Motor is without brushes, commutators and slip rings. Induction motor is used for smaller loads like fan. It is also used in fixed speed application.

Stepper motor is also widely used in industrial area. It is brushless DC motor. It divides the rotation into equal no of steps. It is used for precise positioning. It is used in scanners, floppy drive, camera lenses, CNC.

Automation for speed control of induction motor and stepper motor involves PLC and SCADA system stands for

programmable logic unit. It is basically used for automation process to control the procedure. It functions logic, sequencing, timing, data manipulation. It is computer system which continuously monitor the state of input device and gives output. SCADA stands for supervisory control and data Acquisition [8]. It is combination of software and hardware to control procedure. The combination of PLC and SCADA work together for controlling the induction motor and stepper motor speed. Human machine interface, networks, database and software is used in the process.

PLC-SCADA monitoring and control provided by variable frequency drive for the induction motor. The working of PLC SCADA and HMI is the basic keyword. HMI monitors and controls the data. There are various controller and sensors are used for collecting and sending the data. PLC and SCADA system is the best choice for the automation process.

The aim for this method is remove all disadvantage.

## 2. Literature Survey

During the last few decades there has been lots of improvement in electrical field. There are several methods and techniques which change the face of electrical background. It becomes easier to control the speed of motors.

M. H. Nehrir proposed technique for speed control of three phase induction motor by stator voltage control. This paper gives us idea about the method used for change control. Various methods for speed control of induction motor including pole changing, stator voltage control, supply frequency control, rotor resistance control. Hence this paper is selected for finalization of the project.

Paper of Munoz Garcia proposed and analyzed control scheme based on constant volts per hertz (v/f) method using low cost and open loop sensors. This research paper, we found the method speed controlled technique of induction motor and for PWM techniques. This method is superior than other.

Paper of nehrir, aim at the integration of series-active and shunt-active filters which compensate for voltage flicker/imbalance, reactive power, negative sequence current, and harmonics. third research paper gives idea about the equipment's used in speed control techniques and its performance analysis on induction motor speed and their ratings.

This research paper was helpful in selection of ratings of different components

### 3. Components

#### A. Programmable logic controller (PLC)

It is hardware was founded by Richard E. Morley. It is type of digital computer which is mainly used for automation process.it has a central processor unit, memory, output.

The central processor accepts the data, status information from sensor, executes the program and stored in the memory.it gives proper output to the switches. PLC has four stages.

1. Input scan which detects the state of input devices.
2. Program scan which executes the program logic.
3. Output scan will energize or de-energize output devices.
4. Housekeeping will communicate with all programming terminals. Nexgenie 1000 PLC is used.



#### B. Supervisory control and data acquisition (SCADA)

It is software used for collection the data, display on monitor. It can remove the errors quickly to increase the life of equipment.it can control industrial processes at remote locations.it monitor, gather, process real time data.it directly interact with sensors, valves, pumps, motors, HMI.it record events into log file.it is important for maintain efficiency, right decision and eliminate the errors. The main function of SCADA is collect the data from remote area, display it on monitor and storage of collected data.

#### C. Variable Frequency Drive (VFD)

VFD is used for speed control application. When the load changes, speed increases or decreases accordingly. The voltage induced is directly proportional to the product of air gap flux and frequency. ( $V \propto f \cdot \Phi$ ). Speed can be controlled by increasing or decreasing supply frequency.

#### D. Three phase Induction Motor

Induction motors is widely used in industries, manufacturing

process. It consists of stator, rotor. It is very simple in design.it is cheaper in cost.

Synchronous speed:  $N_s = 120 \cdot f / p$

F=supply frequency

P=number of poles

Speed control in motor is done by stator and rotor side.

*Stator method:* v/f control method, multiple stator winding method, polar amplitude modulation method.

*Rotor method:* Adding external resistance on rotor, cascading control method.

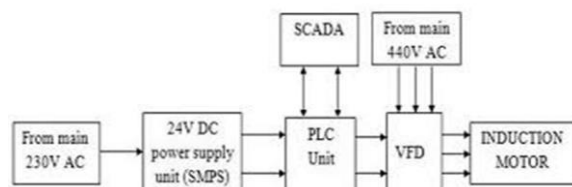
#### E. Stepper motor

Stepper motor is also known as stepping motor, which divides its rotation in equal no of steps. It is electromechanical device. It is brushless DC electric motor. It is low cost, simple in construction, reliable, operate in any condition. Speed control could be obtained, by increasing or decreasing the step width(pulse), applied, for decreasing and increasing speed respectively. Speed control is done by applying series resistance, gearboxes, voltage regulation.

### 4. Proposed Model



Block diagram:

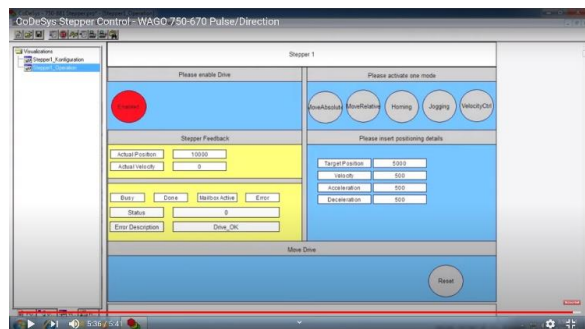
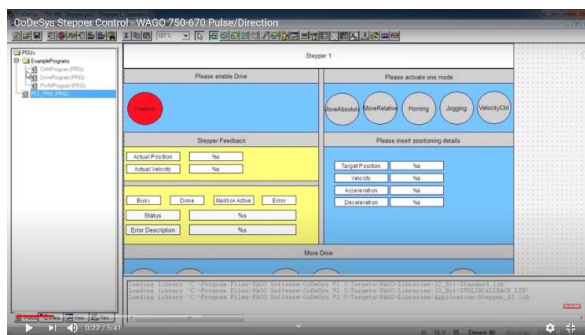


The block diagram is shown in figure. It consists of 230V and 440V power supply. The 230V supply is converted into 24 DC supply. It is provided to PLC unit. The second supply of 440V is supplied to VFD.SCADA collects the data from remote area and stored in it. The PLC controlled VFD and VFD controls the speed of motor. PLC used ladder logic for the operation. The speed is controlled by changing frequency which is done by VFD. By changing frequency, the speed of motor can be controlled.

### 5. Methodology

1. Select the motor according to needed rating and application.
2. Now, drive the program in open loop configuration
3. Program should be connected to the encoder.
4. Once program is connected, then drive program in closed loop configuration.
5. It is program for control induction or stepper motor.
6. SCADA screen is designed for control induction or stepper motor.
7. PLC, Encoder, motor will be integrated to form complete prototype.
8. Hardware are the important backbone system.
9. The hardware components are the backbone of the system. The normally closed part of the FORWARD push button is connected in series with R coil, and the normally closed part of the REVERSE push button is connected in series with F coil.
10. If the motor should be running in the forward direction and the REVERSE push button is pressed, the normally closed part of the push button will open and disconnect F coil from the line before the normally open part closes to energize R coil.
11. The normally closed section of either push button has the same effect on the circuit as pressing the STOP button.
12. In industry the induction motor plays an important role due to its low cost and simplicity.
13. By implementing a monitoring and control system for the speed of Induction or Stepper motor, the motor can be used in high performance variable-speed applications

### 6. Result Analysis



The motor speed of Induction or Stepper motor can be controlled by varying supply frequency. Voltage induced is directly proportional to product of frequency (f) and air-gap flux( $\Phi$ ). terminal voltage can be considered proportional to product of frequency and flux.  $V \propto f \cdot \Phi$  Effect of supply frequency changes without terminal voltage change: Reduction of frequency without change in terminal voltage will cause an increase in the air gap flux thereby saturating the motor. It will cause the increase in magnetizing current, core loss and stator copper loss and cause distortion in line current and voltage and produce high-pitch noise. Increase of supply frequency without change in terminal voltage will cause decrease in flux therefore leading to reduction of torque capability of the motor. the Torque-Speed characteristics of motor supplied directly from the main supply. Torque speed characteristics of motor.

### 7. Future Scope

The advancement in this project can made by implementing the SCADA system in monitoring the soft starting and operation in the conveyor motors. This increases the accuracy of the system to the maximum level. SCADA system completely avoid the man power, since it is a fully automatic system. The SCADA system of control costs higher than the PLC system of control. Hence, PLC becomes cost effective and perfect for the industry. Can be used in normal induction drive, phase induction motor drive, frequency controlled and vector-controlled technique. Can be used for Field Weakening Control of Induction Machine.

### 8. Conclusion

This paper describes the speed control of induction motor and stepper motor using PLC SCADA system with working details. From this, we can conclude that speed control of induction motor and stepper motor

is done very accurate and precise. This is the efficient method for control. It is most advanced technique design. It is available in online or offline mode so there is less chance of error. It has been concluded that by applying modern technique it improves its performance, reduce ripple factor. This proposed system is very accurate, precise, convenient for controlling induction and stepper motor using PLC and SCADA system.

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