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TESTING THE INDUCTION MOTOR VOLTAGE, CURRENT, TORQUE, SPEED, POWER AND EFFICIENCY USING ARDUINO UNO

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ABSTARCT: *Induction motors are the "workhorses" of industry and are most widely used electrical machines. Induction machines are relatively reliable and robust due to their simple design and well-developed manufacturing technology. In induction motor manufacturers are test voltage, current, speed, power, torque and efficiency. The tests were separately performed or calculated by some other parameters. Due to these steps consumes more time. This project aims to reduce the time consumption of testing, by tests of induction motor are performing in same time. Due time reduction quality and production is increase. This project is build by the "ARDUINO UNO" with help of embedded system.*

KEYWORDS: *Arduino Uno, Embedded system, Tests, Voltage, current, speed, power, torque, efficiency.*

I. INTRODUCTION:

Induction motor is an electromechanical drive and it converts electrical energy into mechanical energy. The induction motor operated by the principle of faradays law of electromagnetic induction and Fleming's right hand rule. Induction motors are low cost and it requires less maintenance due to these reasons induction motors are widely used. Electrical power is the input of motor and mechanical power is the output of motor.

Induction motor types:

- Single phase induction motor
- Three phase induction motor

Induction motor manufacturers use the individual parameter testing method and calculations. Due to the testing of individual parameters takes more time for complete testing of the motor.

By using of arduino uno, parameters are tested and calculated simultaneously because of this process time consumption is reduced. Proximity sensor is used to measure the speed of the motor. Potential transformer is used to measure the voltage of the motor. Current sensor is used to measure the current level of the motor and input power & efficiency are calculated by these parameters. LCD displays the data from the controller [arduino uno].When the time of testing process reduce it increase the production and quality of the motor.

Speed = 120f/p rpm

Where, f- frequency

p- Number of poles

Induction motor output Power = 2πNT/60 watts

Where, N- synchronous speed

T- Torque

Efficiency = output power/input power

II. EXISTING SYSTEM:

Induction motor parameters are measured separately. Speed is measure by tachometer, current is measure by ammeter and voltage is measure by voltmeter. Input power of induction motor is measured by wattmeter. Induction motor torque, output power and efficacy are calculated by manually.

III. PROPOSED SYSTEM:

Induction motor parameters are measured by sensors and induction motor power and efficiency are calculated automatically by arduino uno controller finally all parameters are displayed.

IV. BLOCK DIAGRAM:

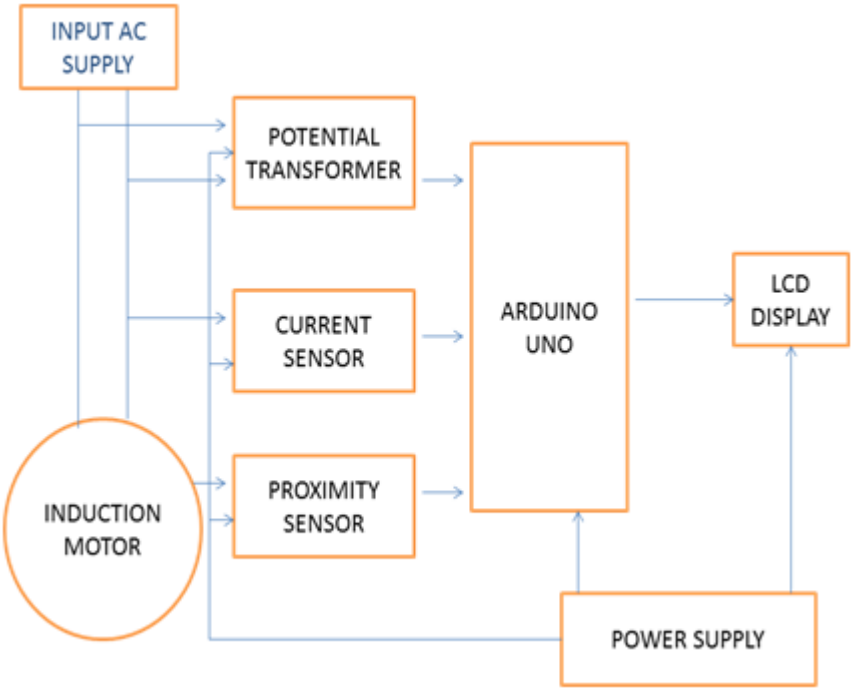

Figure 1 Block Diagram

Proximity Sensor:

Proximity sensor is used to measure the speed of the rotor. It counts the revolutions of rotor. Normally proximity sensor is used as metal detector. This is placed nearly to pulley of motor. A proximity sensor detects an object when the object approaches within the detection boundary of the sensor. Proximity sensors are used in various facts of manufacturing for detecting the approach of metal objects. Various types of proximity sensors are used for detecting the presence or absence of an object.

Current Sensor:

Current sensor is used to sense the current flow of motor. Current sensor work like as current transformer. Central to all of the AC power transducers is the measurement of current. This is accomplished using a current transformer (CT), a "donut" shaped device through which is threaded the wire whose current is to be measured. A current transformer is a type of "instrument transformer" that is designed to provide a current in its secondary which is accurately proportional to the current flowing in its primary.

Potential Transformer:

Potential transformer used to measure the input voltage of the induction motor. Potential transformer is one of the type of instrument transformer. It converts the supply voltage to a voltage level suitable for a meter. The voltage transformer has errors that have been measured and can be applied to calibrate the meter. Transformers (sometimes called "voltage transformers") are devices used in electrical circuits to change the voltage of electricity flowing in the circuit. Transformers can be used either to increase the voltage (called "stepping up") or decrease the voltage ("step down").

LCD Display:

Liquid Crystal Display (LCD) is display device which is used to display the motor parameters. Liquid crystal cell displays (LCDs) are used in similar applications where LEDs are used. These applications are display of display of numeric and alphanumeric characters in dot matrix and segmental displays. When sufficient voltage is applied to the electrodes the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarizer, which would result in activating/highlighting the desired characters. The power supply should be of +5v, with maximum allowable transients of 10mv. To achieve a better/suitable contrast for the display the voltage (VL) at pin 3 should be adjusted properly. A module should not be removed from a live circuit.

Power Supply:

Power supply produces a sufficient voltage for controller and other devices of circuit. DC supply devices are built up the circuit. Power supply circuit contains rectifier circuit and regulator circuit. 12volt DC supply is sufficient voltage for circuit component.

Reason for Using the Arduino Uno:

Arduino uno is very compact, cheap and it is very easy to program. Arduino uno interface to personal computer is simple. Arduino uno used in both analog and digital circuits and also it produces both analog and digital outputs.

Introduction to Arduino Uno:

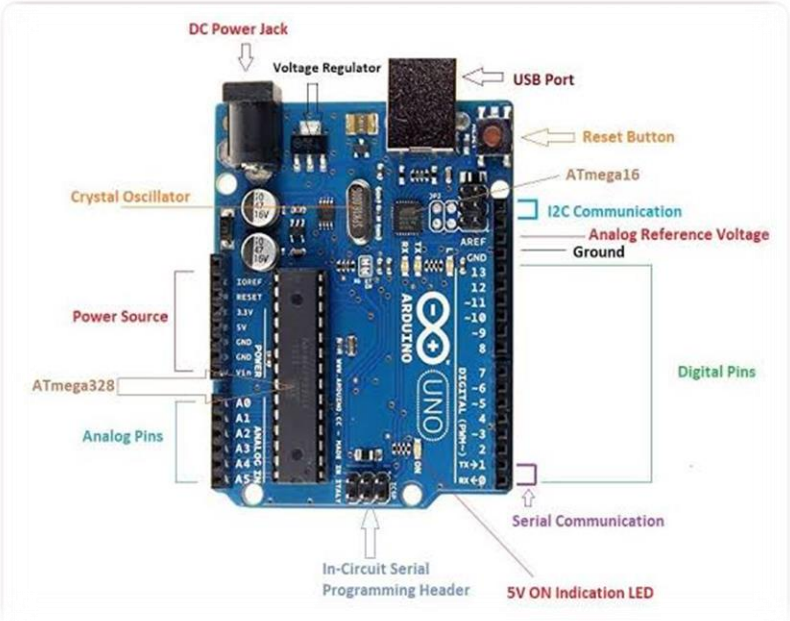

Figure 2 Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Specifications:

- Microcontroller - ATmega328
- Operating Voltage - 5V
- Input Voltage - 7-12V
- Input Voltage (limits) - 6-20V
- Digital I/O Pins - 14
- PWM output Pins - 6
- Analog Input Pins - 6
- DC Current per I/O Pin - 40 mA
- SRAM - 2 KB
- EEPROM - 1 KB
- Clock Speed - 16 MHz

Programming:

The Arduino Uno can be programmed with the Arduino software (download). Select "Arduino Uno from the Tools > Board menu (according to the microcontroller on your board). For details, see the reference and tutorials. The ATmega328 on the Arduino Uno comes pre burned with a boot loader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files). You can also bypass the boot loader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header; see these instructions for details. The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available . The ATmega16U2/8U2 is loaded with a DFU boot loader, which can be activated by:

- On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2.
- On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode.

V. FLOW CHART:

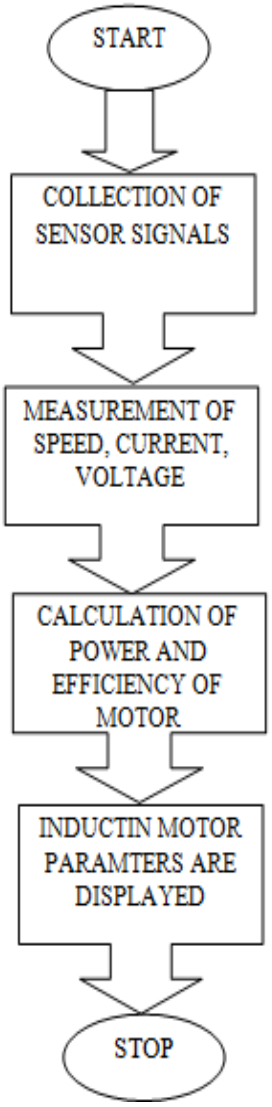

Figure 3 Flow Chart

Collection of sensor signals:

It collects the signals from the current sensor, proximity sensor and potential transformer. These signals are input to the arduino uno controller.

Measurement of speed, current and voltage:

As per the signal from sensors and potential transformer, then controller measures the input parameters like speed in rpm, current in ampere and voltage in volts.

Calculation of power and efficiency:

Induction motor's input and output power is measured by input quantities like voltage, current and speed. Efficiency of induction motor is calculated by input and output power.

Induction motor parameters are displayed:

All induction motor parameters are displayed in liquid crystal display [LCD]

VI. LITRATURE SURVEY:

1. Development of a neural network-based diagnostic tool for detecting the severity and exact percentage of stator inter-turn faults in three-phase induction motors by simulation.

2. Examined the impact of PQ disturbances on single and three-phase induction motor performance using laboratory testing.

3. Efficiency estimates were made with Artificial Neural Networks(ANN), which is optimization-based estimation method with using data of 307 induction motors' from three different companies. The results are very close to the efficiency values given in catalogue values.

4. It is implemented to control the speed of split phase induction motor by controlling load voltage depends upon the ratio of ON and total (ON+OFF) periods or number of ON and OFF cycles of the supply voltage.

5. The influence of die cast rotor fill factor on the starting torque is investigated based on the porosity and fill factor distributions measured from actual aluminum die cast rotors.

6. To prevent an explosion due to hot spot on the surface of the motor, flameproof induction motors are subjected to heat run test to determine the maximum surface temperature and temperature class with respect to the ignition temperature of the surrounding flammable gas atmosphere. This paper highlights the design features of flameproof motors and their surface temperature classification for different sizes.

7. The operational performance of torque versus speed characteristics and the efficiency over the speed range under the rated (continuous) and overload condition were investigated. Finally, the designed inverter-driven IM was developed and the performances of the induction motor operating in three typical modes were tested respectively.

8. A single layer winding is designed for 15 kW, 4-pole premium efficiency induction motor as a solution for cost reduction and improving the efficiency. The dimensions of the optimized motor are kept same as that of the existing double layer motor. As a consequence, the production time as well as the cost of the motor is reduced at a greater extent.

9. An artificial neural network (ANN) primarily based space vector pulse width modulated direct torque control (DTC) scheme to control speed and torque of IM drive. A neural network controller is proposed to replace the conventional PID controllers to enhance the drive's performance.

VII. ADVANTAGES:

- Equipment size is reduced
- Operation speed is increased
- Low power is sufficient for operation
- Accurate parameter values are measured

VII. CONCLUSION:

Thus the speed was sensed by the proximity sensor, voltage was measured by potential transformer and current was measured by current sensor. Input and output power of induction motor was calculated by sensed motor parameters and efficiency was calculated by input and output power of induction motor. All the parameters were displayed and whole process was controlled by arduino uno controller. In future, power factor of motor and temperature of motor are may measure.

IX. FUTURE WORK:

Power factor, motor temperature, motor losses and other motor parameters are may measure and calculate for find better motor specifications.

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XI. BIOGRAPHY:

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