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SPEED CONTROL OF SINGLE-PHASE INDUCTION MOTOR USING ARDUINO AND NODE MCS

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Abstract: In industry and domestic applications, Induction Motors account for more than 85% of all motors used However, DC Motors require commutators and brushes which are hazardous and require maintenance. Hence Induction Motors are preferred as many of the industries use induction motors. So, controlling of induction motor plays a very vital role. We use a Wi-Fi module to control the circuit which is connected to the motor. Wi-Fi is interfaced with a microcontroller. The Wi-Fi module sends the signal to the AVR Microcontroller. The AVR microcontrollers decode the signal and send to the opto-coupler then the respective opto-coupler activates its circuit and gives the change in speed of the induction motor with respect to the change in the firing angle of TRIAC.

Keyword: – IOT MODULE, TRIAC, Transformer

I. Introduction

Induction motors have been used widely in different fields ranging from domestic appliances to industrial machinery. This necessitates a speed control mechanism that is efficient and is also safe to use. Also, the induction motor can be run in either of the two directions which is quite useful in many applications. The Induction Motor Speed And Direction Controller Project serves the purpose of controlling the speed and direction of the induction motor. The induction motor runs through a direct AC line the amount of power given to it decides to what RPM it rotates. We can modulate the power of the AC line to vary the speed of the induction motor through AC driver circuitry. An Atmega family microcontroller is used to give PWM power to an opto-coupler which drives the TRIAC giving supply to the induction motor. Instructions to the microcontroller are fed through a cell phone connection to the system. In this way, this project proves to be quite useful in handling an Induction Motor for its speed and direction.

II. BLOCK DIAGRAM:

The overall block diagram of the project is shown in Figure. An ATmega328P microcontroller has been used in the project. The microcontroller is interfaced with the esp8266 (Node MCU) WiFi IOT module through serial pins (Rx,Tx). A capacitor start/run single-phase induction motor is used in order to control the speed and direction of the same. A 230/9V step-down transformer is used to supply power to the microcontroller circuit along with the zero-crossing detector circuit. A TRAIC is connected as a switch in series with the Induction motor, and TRIAC is controlled via microcontroller through an opto-Isolator (moc3021) after getting a low pulse from zero crossing the detector circuit whenever the input AC supply crosses zero. A zero-crossing detector circuit is connected to a microcontroller via an opto-Isolator (4n25). Two 5V DC relays have been used for controlling the direction of single-phase induction motors which are controlled by microcontrollers. An IOT-based Blynk app (mobile app) is implemented for controlling the speed and direction remotely.

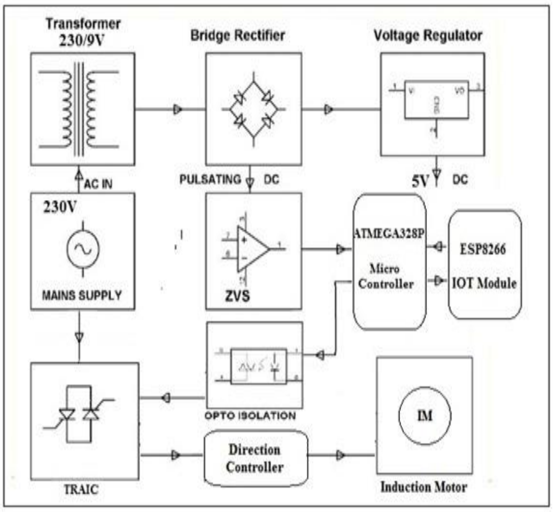

Figure 1: Block Diagram

III. Hardware Implementation

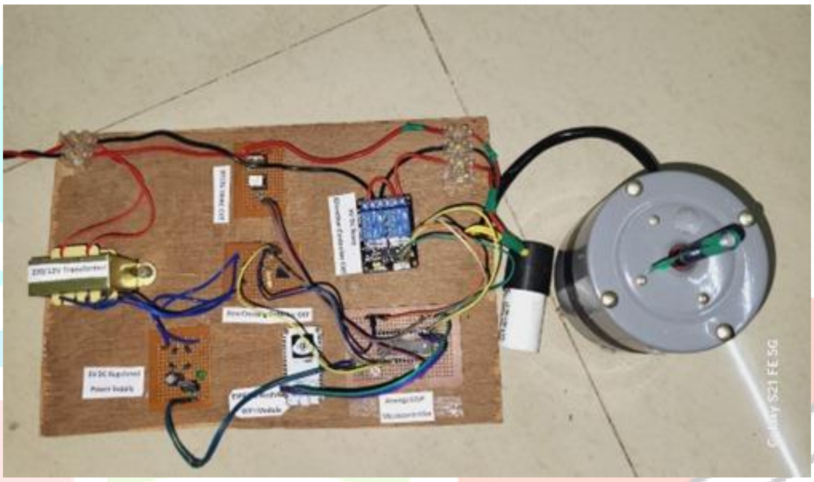

Figure 2: Real Image of the Project

1. Speed control of the motor.

The microcontroller continuously receives data from Node MCU via a serial port having digital pins 11 & 12. The slider button gives the value for speed control in integer form ranging from 5 to 15. Node MCU receives this value and sends it to the microcontroller. Further, the microcontroller calculates the amount of delay to the firing pulse for the gate terminal of TRIAC based on the input integer value of the slider. The gate pulse signal is given from digital pin 7 of the atmega328P microcontroller. In the Blynk app, the 'V6' virtual pin is used for the slider for controlling the speed of the motor. The delay for the gate signal is saved into the int variable 'Firing delay', which is mentioned in the code. Thus, the voltage across the motor varies based on the firing delay given to the gate terminal of TRIAC. The average voltage across the motor can be calculated as V= (2Vm/π) Cosα. An α is the firing delay of the firing pulse given to the gate terminal, which is calculated as (Firing delay/10ms) x180°.
As the period of AC 50Hz is 20ms, for a half cycle (180°) it will be 10ms. Thus, we have varied the delay value i.e. "Firing delay" variable in the program code from 0 to 10ms.

Therefore,
α = (Firing delay/10ms) x180°.
Suppose,
Firing delay=2ms, then α= (2/10) x180°= 18°

For Firing delay= 6ms, then α= (6/10) x180°= 108°

Hence, it can be seen that the firing delay α varies with respect to the delay given to the gate signal. Thus, the voltage across stator varies with respect to the α.

2. Direction control of motor

The direction of the motor is controlled using two relays of 5V DC operated by the microcontroller. An arrangement has been made to change the direction of the motor in either direction by changing the position of the capacitor connected to either to main winding in series or the starting winding in series. Whenever the relay-1 is in an ON state, the motor will run in a clockwise direction as the capacitor remains in series with the starting winding, whenever the relay-2 is in an ON state, the motor will run in an anticlockwise direction as the capacitor will be connected in a series with the main winding.

The virtual pin 'V8' is used for controlling the direction of the motor in the Blynk app. The direction of the motor is controlled with the help of a switch created in the Blynk app, which sends an integer value for each direction. '3' integer for anticlockwise direction and '4' for clockwise direction. The microcontroller receives these values and takes necessary action to control the relay switch based on the signal received.

Also, a module has been created in the Blynk project to control the power supply to the motor, in order to turn ON & OFF the motor. ON/OFF switch is created, which gives output out as '1' for 'ON' and '2' for the OFF state of the motor supply. The virtual pin 'V1' is used for the power ON/OFF switch. Also, a power LED is used to indicate the power supply to the motor.

IV. Observation

The Arduino microcontroller continuously receives the input values from ESP8266 NodeMCU serially. The IOT module receives data from the Blynk app through the Blynk server, which provides real-time data to the microcontroller for performing operations. The slider switch in the Blynk app changes the speed of the motor, the speed (rpm) can be seen in the Blynk app. The power ON/OFF switch controls the power supply to the motor by turning ON/OFF the relays. The switch controlling the direction of the motor either in a clockwise or anticlockwise direction gives accurate results. for the clockwise direction, relay-1 turned ON, whereas for anticlockwise direction relay-2 turned ON.

V. Methodology

An ATmega328P microcontroller has been used in the project. The microcontroller is interfaced with the esp8266 (NodeMcu) WiFi IOT module through serial pins (Rx, Tx). A capacitor start/run single-phase induction motor is used to control the speed and direction of the same. A 230/9V step-down transformer is used to supply power to the microcontroller circuit along with a zero-crossing detector circuit. A TRAIC is connected as a switch in series with the Induction motor, TRIAC is controlled via microcontroller through an optoIsolator (moc3021) after getting a low pulse from zero crossing the detector circuit whenever the input AC supply crosses zero. A zero-crossing detector circuit is connected to a microcontroller via an optoIsolator (4n25). Two 5V DC relays have been used for controlling the direction of single-phase induction motors which are controlled from the Microcontroller. An IOT-based Blynk app (mobile app) is implemented for controlling the speed and direction remotely.

VI. Conclusion

The Single-phase induction motor speed controlling based on Android mobile phone" was designed such that to control the speed of the AC motor using the Wi-Fi control technique by making use of a real control method to control the speed of the motor using Android mobile with Wi-Fi communication. We are also monitoring phases. Compared to other methods like frequency control, PWM method, TRAC control, and Thy raster firing angle control this method is less expensive and design is easy.

VII. Future scope

The future scope will be controlling the speed of three three-phase induction motors likewise that of the single-phase induction motor using Wi Fi module.

Also, we can use a GSM module instead of Bluetooth technology to control the speed of the induction motor.

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