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[Aathinarayanan, 5(12): December2018] ISSN 2348 – 8034
DOI- 10.5281/zenodo.1884300 Impact Factor- 5.070

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

SHADED POLE MOTOR SPEED CONTROL BY SMART PHONE

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Abstract

Now a day's all the Industries are being upgraded to Industry4.0 in Wireless Monitoring and Controlling of all the electrical appliances. In this regards our project is mainly focused on controlling the speed of the Shaded Pole Induction Motor with the help of Android platform, ESP8266 WiFi Module and ATmega328 Microcontroller. The android is an open source operating system, which operates the smart phone and acts as a controller, wherein Smart Phone acts as a transmitter while ESP8266 (WiFi Module) acts as the receiver in ATmega328 Microcontroller. The data sent from the Smart phone is received by Microcontroller, which will send triggering signal to the Gate pin of TRIAC through optical isolator. So the Voltage to load connected in series with TRIAC is controlled based on received signal. So speed control of shaded pole induction motor is achieved.

Keywords: *AC controller, AC Motor speed control, IoT, Phase control, WiFi.*

I. INTRODUCTION

The speed of Single phase Motor is controlled using Smart Phone, WiFi Module and Microcontroller. The triggering angle to the TRIAC is controlled, thus the speed of AC motor from 0% to 100% can be varied. For the quality improvement of product adjustable speed and constant speed may be required for much industry applications. In recent trends, various techniques are available for the selection of speed of drive system. In past years there has been a most demand in industry for adjustable speed drives. Fan, pump, Compressors, domestic applications and paper machines are using variable speed drive. Speed modulation of a single phase Induction motor is achieved by some electrical means, such as reducing supply voltage, by auto-transformer, or by switching windings to change the number of stator poles for different operating condition as required. For controlling the motor speed, the applied voltage can be varied [1]. The TRIAC is used to control the phase voltage with triggering circuit [1]. Here the controlling range is increased by WiFi Module used with Microcontroller as well as it can be upgraded to the level of Internet of Things [2].

II. BLOCK DIAGRAM

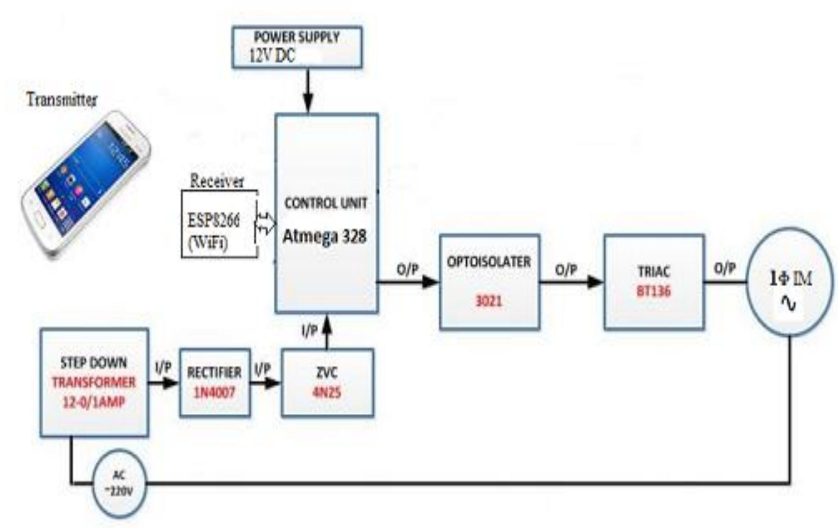

Fig.2.1Functional Block Diagram

2.1 Methodology

Fig 2.1 shows the fictional block diagram of the overall work. The project used Atmega328 Microcontroller as Brain of the system, which is getting a DC 5V from power supply which contains step down transformer, Rectifiers and Regulators. The Atmega328 microcontroller is interfaced with the ESP8266 WiFi module that acts as receiver to the android smart phone application. The required data to control the speed of induction motor will be provided by smart phone application to the controller via WiFi. The controller that decodes received signal will trigger the gate pulse of TRIAC through opto-isolator.

2.1.1 ZVC Detector

Zero Voltage Crossing Detector Circuit made by as shown in fig2.2. The AC voltage from the Power supply is stepped down by transformer to 12V, which is fed to the full bridge rectifier circuit using 1N4007 diodes. The rectified voltage is given to input pins of 1 and 2 in 4N25 opto-coupler. At pin 1, there is an anode pin of LED and at pin 2 is the cathode of it. The 4N25 opto-coupler has Base, Collector and Emitter with pin numbers of 6, 5 and 4 respectively. The base of the in-built photo-transistor is grounded and the output is taken from the Collector of the photo-transistor. So the photo-transistor actually operates like an LED which gets forward biased when the photo-diode glows. The collector pin of photo-transistor is connected to pin 2(INT0) of the Arduino.

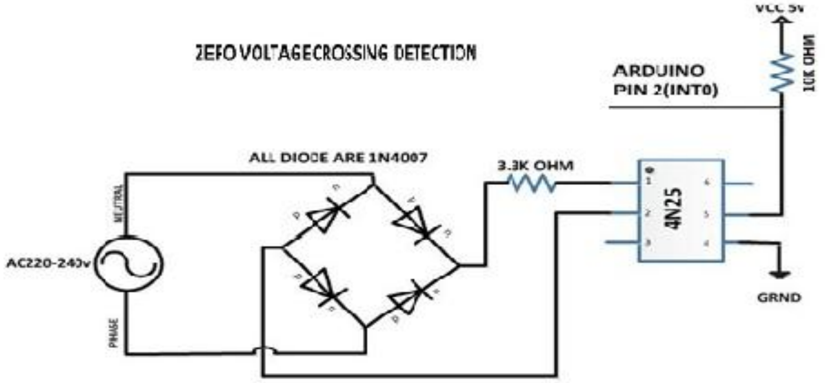

Fig.2.2 Zero Voltage Crossing Detector

2.1.2 Opto-Isolator

Opto-Isolator EL3021 has been connected as shown in fig 2.3.EL3021 is a photo-DIAC type opto-coupler which is used for controlling AC devices. The EL3021 has the anode and cathode of pin number 1 and 2 respectively. The DIAC has pin number 5 and 6 respectively. Pin number 1 is connected with Arduino pin 10. The DIAC pin is connected with BT136 TRIAC pin number 2 AND 3 respectively. The load is connected between pin number 1 of BT136 and neutral respectively.

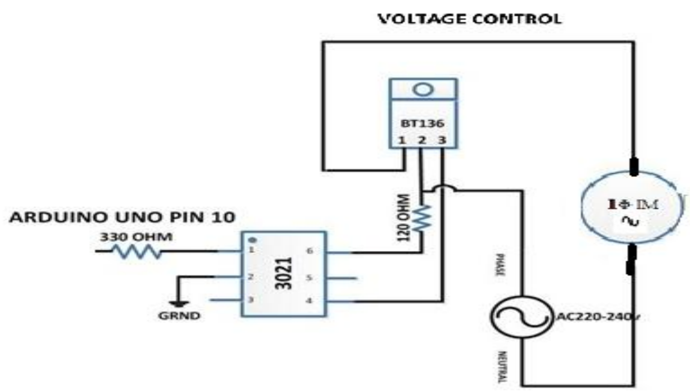

Fig.2.3 Opto-Isolator & TRIAC

2.3 TRIAC Phase Control

Phase of AC voltage is controlled by giving pulses to the gate pin of BT136 TRIAC. When power is switched on all the pins of Ardunio are initialised. The zero voltage crossing is achieved with 4N25 circuit, wherein 230V AC supply is stepped down to 12V AC by the transformer and rectified by the 1N4007 diode with full-wave rectifier. The converted DC voltage drives the IR diode of 4N25 and forward biased for voltage more than 1.1 Volt. If the rectified wave is above zero voltage crossing, phototransistor 4N25 remains in forward biased condition, and then circuit is closed to pin 2 of Arduino to ground. Therefore a LOW logic is received at pin 2 of Arduino. When voltage level approaches to zero voltage crossing, the IR diode in 4N25 will not get the required voltage for forward biasing. So, the phototransistor of 4N25 in unbiased condition and pin 2 of Arduino will get a HIGH pulse.

The zero voltage crossing detector, interrupt the controller at every zero crossing of input AC voltage. At every instant of interrupt in pin 2(INT0), the microcontroller will calculate the firing delay based on firing signal received from the smart phone application via ESP8266 WiFi module and sent firing signal to the gate pin of BT136 TRIAC.

The Arduino detects the zero voltage crossing and determines a firing angle based on the data received through WiFi from smart phone. The time interval based on mobile data reading is calculated in the Arduino Sketch. An interrupt routine sends a HIGH pulse for 50 micro-seconds delay of the time interval which is activated at pin 10 of Arduino. The HIGH pulse, that turns on the IR diode of an EL3021 opto-coupler with calculated time interval. This will turn on the triggering pulse at the Gate terminal of BT136 TRIAC with the same delay equivalent to the calculated time interval. In phase control application using TRIAC, the voltage pulse before the appearance of triggering pulse at Gate terminal of TRIAC gets chopped off while the part of AC voltage wave after the appearance of triggering pulse at Gate terminal of TRIAC remains available for supply to the load.

III. RESULT

The Project setup shown in fig 3.1 comprises smart phone as transmitter and Electronics circuit containing ESP8266 WiFi Module as receiver, which is interfaced with Atmega328 Microcontroller, Zero Crossing Detector used to synchronise the input AC voltage with triggering signal and TRIAC that controls fan speed based on triggering signal from the Atmega328 Microcontroller. The fan is nothing but the single phase shaded pole Induction motor.

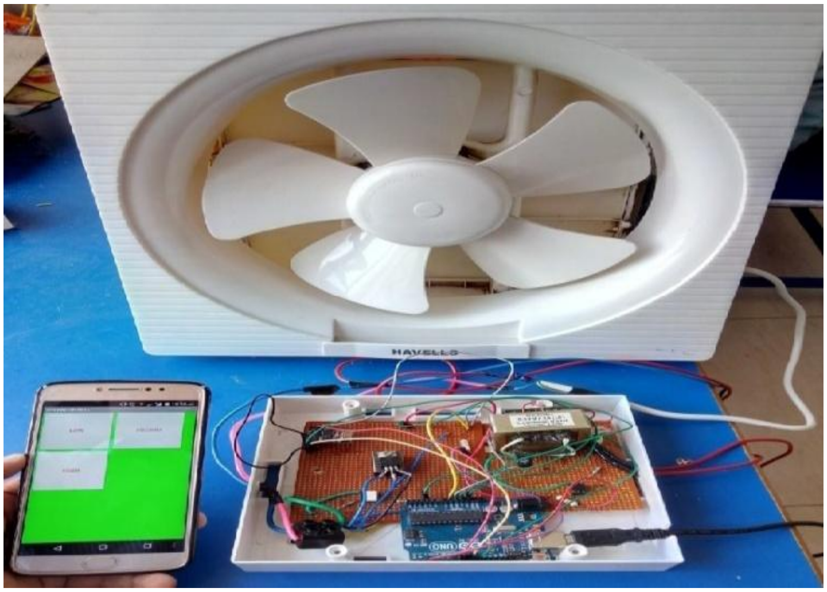

Fig.3.1 Experimental setup

3.1 Mobile Application

The Mobile application has been developed from MIT App Inventor which is open source mobile app development platform. The android application has three buttons as HIGH, MEDIUM & LOW for various speed levels. When the button is pressed from mobile application, the triggering data transferred to Microcontroller through ESP8266 Module. The Microcontroller decodes the triggering data and send triggering signal to Gate pin of TRIAC. Thus the Voltage applied across induction motor has been varied and correspondingly speed also varied. Table 3.1 shows the different values of speed for various firing angle. Fig 3.2 shows the wave form of output voltage obtained across the motor.

Table3.1- Various Speed Level and Voltages

S.NO	SPEED LEVEL	FIRING ANGLE (α)	VOLTAGE (RMS)	SPEED (RPM)
1.	High	45°	220 V	850
2.	Medium	90°	110V	448
3.	Low	140°	40 V	56

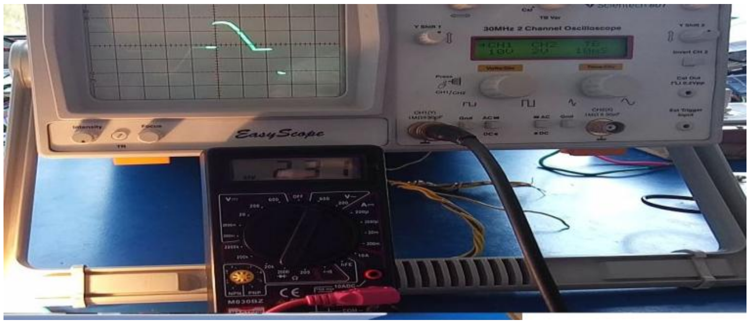

Fig.3.2 Waveform of Output voltage

IV. CONCLUSION

The methodology used in this project has appropriate to the Industry4.0. ESP8266 WiFi module has been used, which increase the range of controlling distance as well as it can be adoptable for controlling the speed anywhere in the world based on the Internet of Things. This project has been enhanced the industrial operation and upgrade the industry to next level. The work carried out here for any single phase Induction motor speed control and in future it can be upgraded to any three phase AC induction motors.

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