International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 04 | Apr-2018 www.irjet.net p-ISSN: 2395-0072

Energy Efficiency Improvement of Induction Motor by Integral Cycle control using ATmega Controller

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Abstract - *At present situation, all house and industries have more than one number of ceiling fan which operates on an average of 10-15 hours/day. So the contribution of fan in the overall energy consumption of house and industry is of considerable value, since there is no existing system which deals with reducing the energy consumed of fan. By our proposed system we can reduce the energy consumption of fan by controlling the supply given to it. To control the voltage a control switch is used in addition with a micro controller. So by effectively reducing the energy consumption of the electric fan, major changes can be seen in overall energy saving in all houses and industries. In Single-phase induction motors for a high starting torque, a capacitor-start capacitor-run arrangement is used, the speed is usually controlled by voltage control methods. This paper 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.*

Key Words: micro controller, Single-phase induction, split phase induction motor

1. INTRODUCTION

In electric fan single phase induction motor is used and it has efficiency about 80 to 85%. So by improving the effective energy consumption of the motor the overall energy saving is improved. To conserve energy, we place a controlling circuit which consist of a semiconductor switch in series with the motor. An arduino is used to control the semiconductor switch. Energy saving is achieved by providing discrete power supply to the motor instead of continuous supply. In fan application, when the power is disconnected the motor tends to rotate for short time duration due to inertia, this action is utilized to achieve the energy saving in this project. The circuit used in this project will ensure desirable performance of the motor at the same time provide discrete power to it. By contineously doing this process the sufficient energy saving can be achieved.

2. LITERATURE REVIEW

Shashank Mishra, et all[1] This paper is implemented to control the speed of split phase induction motor using PWM technique based cycloconverter. The cycloconverter is built on with IGBT due to its improved dynamic performance, efficiency and reduction in the level of audible noise. The output response of the cycloconverter is applied to the split phase induction motor and various output response of motor have obtained then observed the main & auxiliary winding current and speed-torque characteristics of the split phase induction motor. Single phase cycloconverter are developed output response 2 & 4 times to input response by two techniques.

Syed JamilAsghar[2] In Single-phase induction motors for a high starting torque, a capacitor-start capacitor-run arrangement is used, the speed is usually controlled by voltage control methods. Either a resistance or inductor regulator in series or ac phase-controlled regulator, is used for this purpose. The regulator resistance causes significant power wastage while inductor lowers the PF. It had been successfully applied to RL loads too. Although reduces electromagnetic interference (EMI) it introduces sub-harmonics in the line The controlled load voltage depends upon the ratio of ON and total (ON+OFF) periods or number of ON and OFF cycles of the supply voltage

Mohammed. S. AL-KHESBAK, et all[3] In conventional cycloconverters, the alternating voltage at supply frequency is converted directly to a Lower frequency voltage without any intermediate DC stage. The microprocessor and microcomputer -based circuitry have led to a revival of interest in the cycloconverter principle. Sophisticated control circuits permit the conversion of a fixed input frequency to a variable output frequencyat variable voltage, and such schemes are attractive for AC motor drives. These methods have gained considerable acceptance as schemes in the field of power frequency changers and speed control of induction motors. The envelope cycloconverter proposed in this paper, is based on half cycle selection technique which is considered as a form of integral cycle control. Theoretical and practical behaviour characteristics of a proposed three-phase variable frequency cycloconverter have been presented.

M. K. Yoon[4] They form about 80% of electric motors and about 38% of total electric consumption . It becomes imperative that major attention be paid to the efficiency of induction motors. By using a higher conductivity copper in the windings and increasing conductor cross-sectional area for the decreasing of the primary losses. Better grades and thinner gages of steel laminations also reduce losses. A few methods such as improved fans and bearings performances, reduced air gaps between stator and rotor, and closer machining tolerances are also used for the building of more

efficient motors. First, transient behaviours of the motor are tested during starting time by measuring the torque and the rotational speed.

3. PROPOSED SYSREM

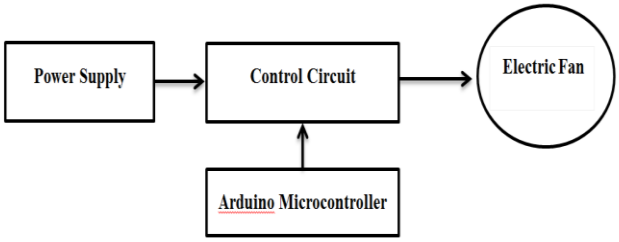

Fig 1: Block Diagram

During conventional operation of the motor, when supply is provided to motor it starts to rotate and reaches rated speed steadily and sustain the speed until any changes happen in speed regulator circuit.

In the proposed method the Arduino microcontroller provides pulse to the switching device present in the control circuit for a period of time (Ton) causing the device to turn-on and power supply is provided to the motor. The Ton period continuous till the motor achieves rated speed. Once the motor achieves its rated speed microcontroller turns-off (Toff) the switch interrupting the supply provided the motor, during this period even though power is not provided the fan continuous to rotate due to inertia and it will take time for the rotor to attain zero speed (T0). The microcontroller will provide pulse to the semiconductor switches turning the switches ON after a few cycle of Toff duration. It can be noted that the supply is provided back to the motor before the speed drops to a noticeable level. This process of providing discrete supply to the motor without affecting the performance of the motor results in reduced energy consumption

Since the power supply is provided to the motor before the rotor comes to stand still position, continuous rotation is achieved and also abnormal rise in current values are not noted during trail run and simulation.

4. COMPONENTS USED

TRIAC

The Triac is similar in operation to two thyristors connected in reverse parallel but using a common gate connection. This gives the triac the ability to be triggered into conduction while having a voltage of either polarity across it. In fact it acts rather like a "full wave" thyristor. Either positive or negative gate pulses may be used. Triacs are mainly used in power control to give full wave control. This enables the voltage to be controlled between zero and full power. With simple "half wave" thyristor circuits the controlled voltage may only be varied between zero and half power as the thyristor only conducts during one half cycle. The triac provides a wider range of control in AC circuits without the need for additional components. The triggering of the triac is also simpler than that required by thyristors in AC circuits, and can normally be achieved using a simple DIAC circuit.

Phototransistor Optocoupler

Assume a photo-transistor device as shown. Current from the source signal passes through the input LED which emits an infra-red light whose intensity is proportional to the electrical signal. This emitted light falls upon the base of the photo-transistor, causing it to switch-ON and conduct in a similar way to a normal bipolar transistor. The base connection of the photo-transistor can be left open (unconnected) for maximum sensitivity to the LEDs infra-red light energy or connected to ground via a suitable external high value resistor to control the switching sensitivity making it more stable and resistant to false triggering by external electrical noise or voltage transients.

CONTROL CIRCUIT

In control circuit we have modified the TRIAC electronic regulator which is used to control the voltage given to the electric fan. The Arduino and semiconductor switch controls the firing pulse given to the TRIAC switch. So the supply will be provided to the motor only when the signal is generated from the ardunio micro controller.

ELECTRICAL FAN

In this project a single phase capacitor start run induction motor with rotating assembly of blades and hub is used. Testing and calculation of energy consumption will be done in real time mounting and operating condition.

ARDUINO MICROCONTROLLER

The microcontroller plays a major role in controlling the Electric fan. It is programmed to effectively control the electric fan's supply. It gives gate pulse to the semiconductor switch such that it turns on and turns off based on this. The programming is done in such a fashion that pulse provided provided to the switch operates the fan in optimal level.

5. CONCLUSION

This proposal project aims to reducing the energy consumption of the ceiling fan without compromising on the performance and at low cost investment. By using this propose method overall energy saving of about 25% is expected for the same duration of operation.

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