INTERNATIONAL JOURNAL OF ADVANCE RESEARCH AND DEVELOPMENT
IJARnD
(Volume3, Issue3)
Available online at: www.ijarnd.com

Energy efficiency improvement of induction motor by integral cycle control using ATMEGA controller

Thirthapriyan[1], Iniya V[2], Ashok Kumar[3], Umesh M[4], Senthil Kumar[5], Balaji P[6]

[1,2,3,4,5]*Student, Knowledge Institute of Technology, Salem, Tamil Nadu*

[6]*Assistant Professor, Knowledge Institute of Technology, Salem, Tamil Nadu*

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.

Keywords: *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 Atmega controller is used to switch the semiconductor device. 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 continuously 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 by 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 Jamil Asghar[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

M. K. Yoon [3] 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 of the decreasing of the primary losses. Better grades and thinner gages of steel laminations also decrease 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 SYSTEM

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 as shown in figure 1.0.

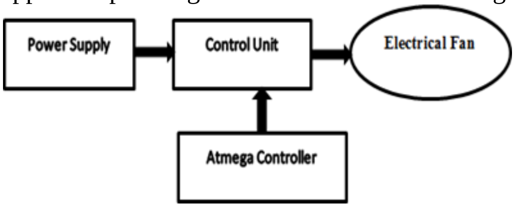

Figure. 1.0

In the proposed method the ATmega 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. EXPERIMENTAL SETUP

By connecting control circuit attached between supply and fan, there is possibility to reduce energy consumption, energy consumed and motor performance is shown in table 1.1.Using Atmega controller triggering Gate terminal of Triac which is connected across fan and given Ac supply by triggering in various time interval energy can by consumed. They are Normal (T=10Min), M1 (Ton=15s, Toff=3s), M2 (Ton=15s, Toff=2s), M3 (Ton=15s, Toff=1.5s), M4 (Ton=10s, Toff=1.5s), M5 (Ton=10s, Toff=2s), M6 (Ton=1s, Toff=20ms)

Table1.1

MOTOR PERFORMANCE	ENERGY CONSUMED
NORMAL	55.44
M1	47.52
M2	47.52
M3	47.52
M4	47.52
M5	43.56
M6	43.56

Normal : Induction motor runs at normal condition where it power consumption is 55.44W in 10Mins, Where it runs at speed of 1370rpm.M1: In this mode where Induction motor runs normal condition for first 30s, by using Triac motor operates in time period of Ton=15s & Toff=3s and power consumption is 47.52W in 10Mins. Motor runs at Avg.speed of 1353rpm. M2: In this mode where Induction motor runs normal condition for first 30s, by using Triac motor operates in time period of Ton=15s & Toff=2s and power consumption is 47.52W in 10Mins. Motor runs at Avg.speed of 1183rpm. M3: In this mode where Induction motor runs normal condition for first 30s, by using Triac motor operates in time period of Ton=15s & Toff=1.5s and power consumption is 47.52W in 10Mins. Motor runs at Avg.speed of 1245rpm. M4: In this mode where Induction motor runs normal condition for first 30s, by using Triac motor operates in time period of Ton=10s & Toff=1.5s and power consumption is 47.52W in 10Mins. Motor runs at Avg.speed of 1256rpm. M5: In this mode where Induction motor runs normal condition for first 30s, by using Triac motor operates in time period of Ton=10s & Toff=2s and power consumption is 43.56W in 10Mins. Motor runs at Avg.speed of 1348rpm. M6: In this mode where Induction motor runs normal condition for first 30s, by using Triac motor operates in time period of Ton=1s & Toff=20ms and power consumption is 43.56W in 10Mins. Motor runs at Avg.speed of 1360rpm.

5. RESULT AND DISCUSSION

By operating Electric fan in various mode energy can be saved it is shown in Figure 1.1

5. a. SPEED CHARACTERS

In the following given modes where speed is varied for fan, where the fan is operated at 1370 rpm at normal operation. For various modes fan obtained average speed is given in Figure 1.2

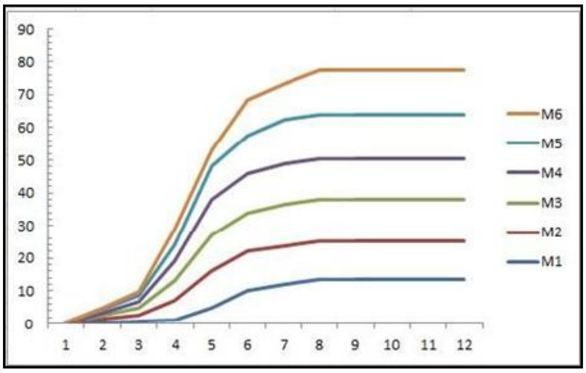

Figure1.2

In M2, M3, M4, M5 motor consumed energy is less compared to normal operation, but the speed is varied for every mode. And also the semiconductor switching time (Ton & Toff) period is varied. For more accuracy in speed M6 is taken in account, where in M5 motor attains speed of 1348 rpm and for every 10s, 2s is supply off for fan. So there is a drastic decrease in speed which can be easily visible for human eye. To make even more accurate M6 is taken in account, here for every 1s there will be 20ms cut off supply, results where there is some minute changes in speed it will not affect air flow for consumer. Normal: Induction motor runs at normal condition where it power consumption is 55.44W in 10Mins, Where it runs at speed of 1370rpm.

M1: In this mode where Induction motor runs normal condition for first 30s, by using Triac motor operates in time period of Ton=15s & Toff=3s and power consumption is 47.52W in 10Mins. Motor runs at Avg.speed of 1353rpm. M2: In this mode where Induction motor runs normal condition for first 30s, by using Triac motor operates in time period of Ton=15s & Toff=2s and power consumption is 47.52W in 10Mins. Motor runs at Avg.speed of 1183rpm.

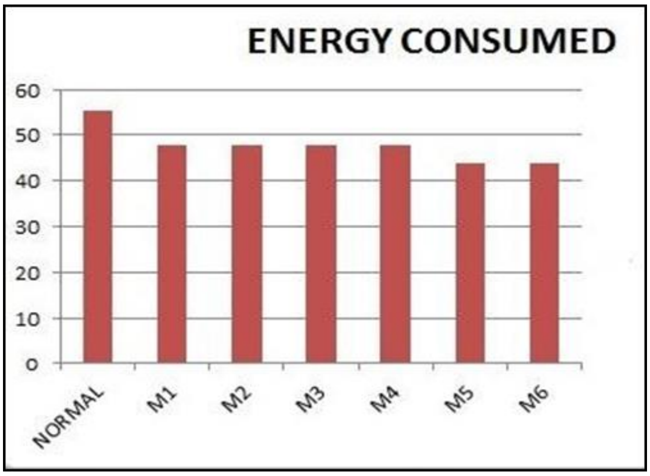

Figure1.1

M3: In this mode where Induction motor runs normal condition for first 30s, by using Triac motor operates in time period of Ton=15s & Toff=1.5s and power consumption is 47.52W in 10Mins. Motor runs at Avg.speed of 1245rpm. M4: In this mode where Induction motor runs normal condition for first 30s, by using Triac motor operates in time period of Ton=10s & Toff=1.5s and power consumption is 47.52W in 10Mins. Motor runs at Avg.speed of 1256rpm. M5: In this mode where Induction motor runs normal condition for first 30s, by using Triac motor operates in time period of Ton=10s & Toff=2s and power consumption is 43.56W in 10Mins. Motor runs at Avg.speed of 1348rpm. M6: In this mode where Induction motor runs normal condition for first 30s, by using Triac motor operates in time period of Ton=1s & Toff=20ms and power consumption is 43.56W in 10Mins. Motor runs at Avg.speed of 1360rpm.

By using this method cost for energy consumption is reduced it's shown in Figure1.3

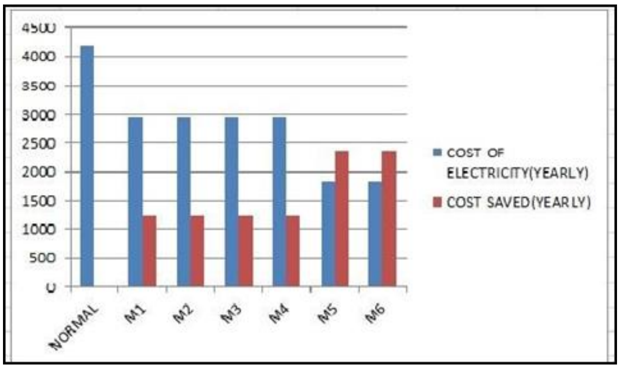

Figure1.3

Comparing with cost of normal operation in M6, 25% of energy is saved. In M6 energy is saved and also speed varied is in considerable.

6. CONCLUSION

This proposal project 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 saved for the same duration of operation.

7. REFERENCES

[1] Bhagawati Patil & Rushali Aute, "Cycloconverter to Control the Speed Induction Motor" International Research Journal of Engineering and Technology", Electronics and Telecommunication Engineering, Vol. 04, Issue 04, April 2016.
[2] Adeeb, E., A. Maqsood and A. Mushtaq (2015). Effect of Number of Blades on Performance of Ceiling Fans. 4th International Conference on Advances in Mechanics Engineering, Spain, MATEC Web of Conferences.
[3] Mahmood.A. L, Lazim. M. T, and Badran, Harmonics phase shifter for a three- phase system with voltage control by integral-cycle triggering mode of thyristors. In: American Journal of Applied sciences, Vol.5, No. 11, 2008, USA.
[4] B. Sai Sindura & B.N. Kartheek,"Speed Control of Induction Motor using Cycloconverter",International Journal of Engineering Trends and Technology (IJETT) Vol. 04 Issue 04 - April 2013.

