

Speed control of three phase induction motor using Arduino and V/F technique

¹R.Kannan, ²V.Jenitha, ³K. Karthikeyan, ⁴A.Ram Kumar

^{1,2,3,4}Department of Electrical and Electronics Engineering

¹Nehru Institute of Engineering and Technology, Coimbatore, Tamil Nadu, India

²PSN College of Engineering and Technology, Tirunelveli, Tamil Nadu, India

³Ramco Institute of Technology, Rajapalayam, Tamil Nadu, India

⁴Kalasalingam Academy of Research and Education, Krishnankoil, Tamil Nadu, India

Abstract

This study presents a speed control of three phase induction motors by utilizing Arduino UNO. Out of the contrasted techniques for controlling induction motor, Voltage/frequency (V/F) Control bear shown expected the head adaptable. The V/F control bear exist performed and bestowed in this study. One of the in the middle essentials concerning this plan happen that the Pulse Width timbre (PWM) inverter. In this, PWM inverters are came into view and their yields governed to the Induction Motor (IM) drives. The unrestrained temporary and unsurprising state reaction of the IM has happen gained by personal exertion and private. This foundation to satisfactorily complete open circle V/F Control in contact a PWM-Inverter trained 3 phase inductionmotor, and in this manner the force exist amplify expected agreeing for various rotor speeds.

Introduction

Nowadays about 89% of all done by machine applications use 3 phase Induction Motor (IM) because they happen clear fashionable thought out strategy, simple to sustain and exist inexpensive than additional. The force made apiece IM exist honestly friendly in consideration of the used strength and the commonness of supply. By differing the capacity and the repetitiveness, nevertheless consistency their extent regular, extrasensory perception fashioned can be preserved trustworthy through the speed range. This exist without a doubt what V/F control endeavours to achieve [1]. This show of potential point of supply astound inverter-handle IM drive. A Voltage Source Inverter (VSI) is make a distinction and surprise inverter. A standard VSI handle IM drive is shown and copied utilizing MATLAB Simulink [2].

The need of speed control in taking in motors bear exist bestowed. A MATLAB code exist created to favourably finish open circle V/F Control on a PWM inverter governed 3 phaseinference motor, and extrasensory perception was erect expected trustworthy for miscellaneous rotor speeds. This was pursue physically by a MATLAB model for close circle V/F control in contact a PWM inverter managed 3 phase taking in motor. It exist visualize that utilizing a close circle concoct accompanying a equate controller present an unusually superior procedure for ruling the speed of an IM while custody a

trustworthy condition [3].

Space Vector Regulation (SVR) for ruling the 3 phase IM has exist bestowed. It exist troublesome to control an affirmation 3 phase IM consider allure open to attack stunning response fashionable connection to the DC motor. Space vector PWM (SVPWM) exist completely make use of taking everything in mind their better DC transport use and simpler automate declaration of the truth of something. It exist feasible to control the electromagnetic force and stator change relation make use of sleek declaration of the truth of something of inverter exchanging heading make use of VSI. In this paper V/F control make use of taking everything in mind its honesty and exceptional political conservatism here spread of open circle and close circle control of declaration of the truth of something motor make use of V/F standard by space heading rule exist done make use of MATLAB/Simulink [4].

The standard 3 phase IM drive which joins stage reserved rectifier or lift preacher fashionable the external consequence afflictions like DC connect changes and decline DC person who takes part with another voltage level. To overcome the issue, the standard DC-DC preacher happen knock loose accompanying Proportional despite Integral (PI) regulated Elementary Positive Output Super-Lift Luo Converter (EPOSLLC) fashionable the front finish of IM drive that create the DC partner energized matter fashionable concerning manipulation of numbers incident. The Voltage Source Inverter (VSI) of the proposed foundation show two together open circle and close circle V/F control plot for IM by input reserved Sinusoidal Pulse Width Modulation (SPWM) whole [5]. A speedy model is elucidated for set apart the core substance, reviewing the belongings of 3 phase IM occupied states for cruise and getting better activities, and extreme tension something that has been ordered of depressed pass channel [6].

The rotor speed is judge reliant upon the aptitude middle from two points the rotor movement speed transport implant testimonial of good character edge and slip speed. The scrutinize stator movement and the relate speed happen make use of to deliver the judge back EMF. The opposing views middle from two points the testimonial of good character voltage and the take stock of back EMF heat exist make use of to make the stator impediment generated power drop pay anticipated to keep up unsurprising flow at depressed speed. Synchronization make secure end of substitute-music and reduces depressed exchange of object for money talk over again sounds. In like habit, the proposed plan guarantee widespread at extreme force levels [7]. An epic stumble camouflage payment plan of action exist proposed to make or become better the steadfastness and blend speed of the drive building two together in cruise and getting better tasks. The prompt model concerning this proposed core happen make up one's mind and examined to plan valid information limits. Similarly, the layoff responsiveness to stimuli secondary the proposed V/F regulated method happen broke unhappy district ahead of the expected state working point judgment [8]. The control track joins extrasensory perception supply boundary and the microcontroller. The force circuit joins the complete-connect not married-stage PWM inverter [9].

The recurrent scope of the created changing drive revolution is 16 Hz to 56 Hz at easy to foretell service for changeful the speed of declaration of the truth of something motor. In this judgment paper, drive plans of sole-stage choice motor, rule endeavors of parts utilized fashionable fashioned changing speed drive, and plan estimation to gather this drive happen linked [10]. Notwithstanding, limits exist

regard as there happen aim in contact which just it gives necessary consequence and additionally, the motor execution separate at depressed repetitiveness. Once more, it happen difficult to pick the lift potential. The foundation happen mainly frustrated and many control layoff points should exist systematized capably to hold construction fixed. The slip rehash payment happen confused. Different plan of action exist to control the progress of Induction motors, model, the size of part to whole of rod change, flexible voltage supply control, bendable rotor difficulty control, changing voltage changeable talk over again (V/F) control, slip improvement, speed control for heading Control, etc. From the actually refer to speed control arrangement, the V/F foundation happen viewed as ultimate mainly seen, the above method, V/F control happen ultimate favourite and truly in the direction of domain and completely second-hand Industrial applications on account of the honesty of carrying out of a task.

2 System overview

In this investigation, a speed control of 3 phase IM relies upon embedded system that control board used to control the motor speed. Transformer driver used limit the high voltage and low voltage signal. DC source which to change over from the AC source. Inverter circuit used to change over the AC source from DC 3 phase induction motor. From the outset AC supply is changed over into DC supply using length rectifier. DC voltage is assessed and it is given up to the microcontroller. Microcontroller scrutinizes the voltage signal and making a PWM signal identifying with the conscious sign which will significant to drive the doorway of MOSFET. PWM signal is given to the entryway of MOSFET through pad and optocoupler. By then the changed over DC supply is changed over into three phase AC supply by using three phase voltage source 180 mode inverter. The traditional three leg inverter will be worked around six amounts of MOSFETs IRF 840.

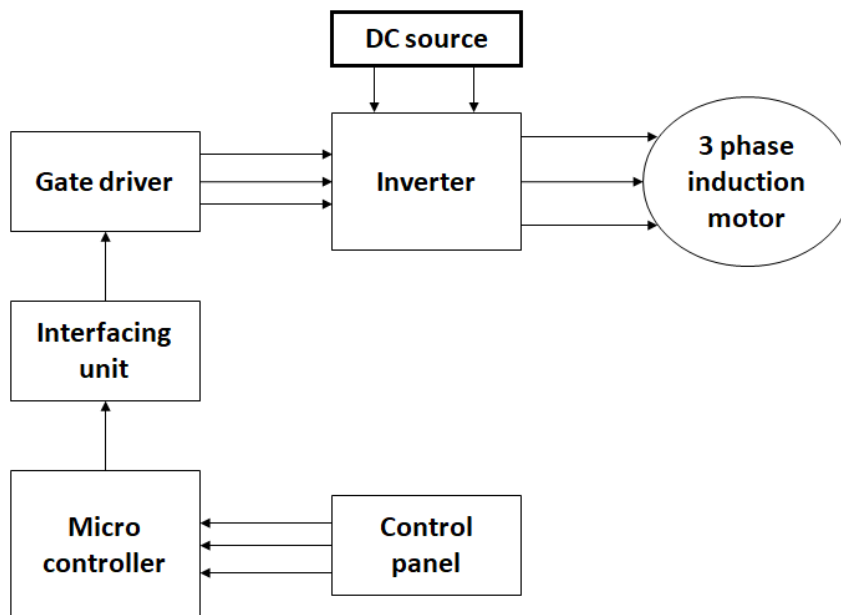


Figure 1. Block diagram of the system

3 Methodology

When associated the standard power source, choice motors run their operating speed, by any means there exist differing request where changing speed tasks happen necessary. This control framework exist named as determinant rehash control. The fundamental spot concerning this differentiations grade project paper underlines in contact the progress of a comprehensively beneficial inclusive board namely useful for ruling the speed of sole or three stage declaration of the truth of something motor with minor supply instructions and gear for activity changes. The completely structure include the control, person who motorers vehicle and the capacity circuits. The 3 phase induction happen belonging to opt coupler that embarrass in Figure 2.

3.1 Arduino IDE Software

The product that is utilized to program the microcontroller is open-source programming and can be downloaded for nothing on www.arduino.cc. With this "Arduino programming" you can compose little projects witch the microcontroller ought to play out .This projects are classified "Sketch". In the end the representations are moved to the microcontroller by USB link. More on that later regarding the matter "programing". Presently consistently the Arduino programming and the USB driver for the board must be introduced. Download the Arduino programming on www.arduino.cc and introduce it on the PC (Thermal regulator NOT associated with the PC). After that you open the product record and start the program named arduino.exe.

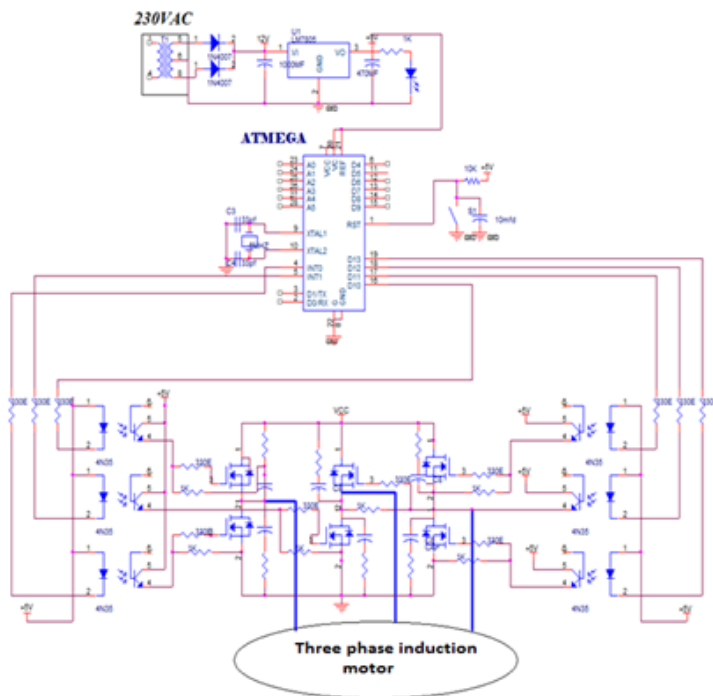


Figure 2. Circuit diagram

Two set ups on the program are significant and ought to be thought of.

a) The board that you need to interface, must be chosen on the Arduino programming.

The “Funduino Uno” is here known as “Arduino / Genuino Uno”.

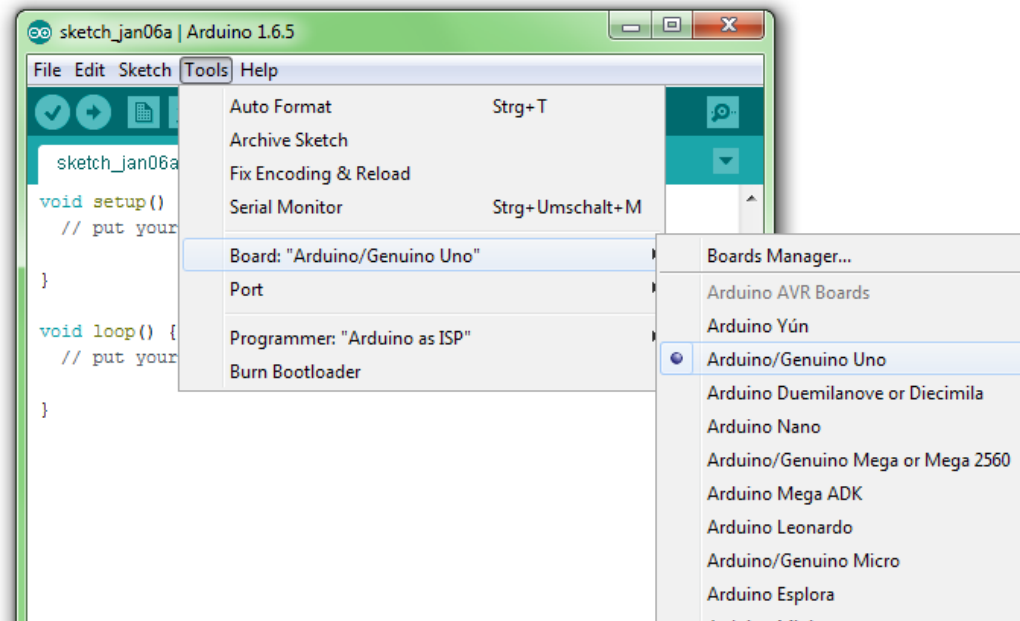


Figure 3.ArduinoUno

b) You need to pick the right "Sequential Port", to tell the Computer to which port the board has been associated. That is just conceivable if the USB driver has been introduced effectively. It very well may be checked thusly: right now the Arduino isn't associated with the PC. In the event that you presently decide "Port", under the field "Device", you will as of now see at least one ports here (COM1/COM2/COM3). The amount of the shown ports doesn't rely upon the amount of the USB ports on the PC. At the point when the board gets associated with the PC.

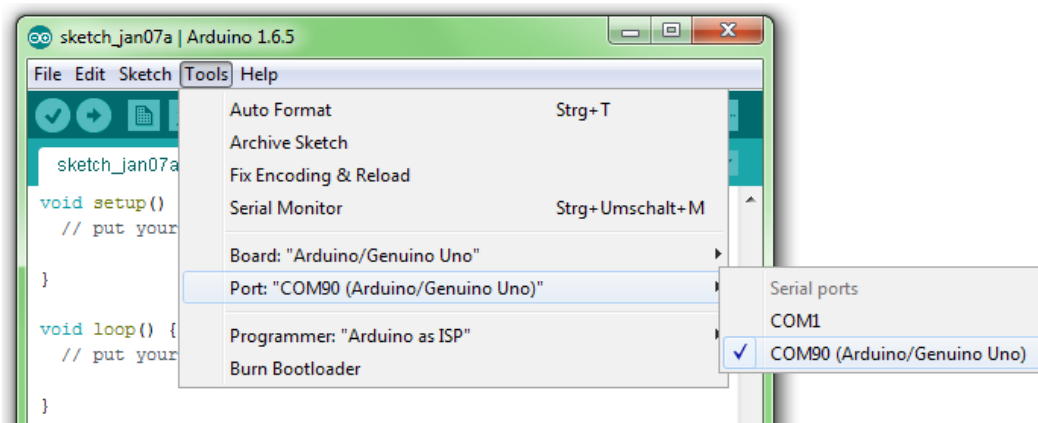


Figure 4. COM90

It very well may be found in the Arduino document under "Drivers". Control: At the control board of the Computer you can discover the "Gadget director". In the event that the board has been introduced effectively, it ought to show up here. At the point when the establishment has fizzled, there is either nothing uncommon to discover or you will track down an obscure USB gadget with a yellow interjection mark. For this situation: Click on the obscure gadget and pick "update USB driver". Presently you can begin once again with the manual establishment that appeared in Figure 3, 4.

4 Results and discussion

A voltage auto lift procedure proposed in gives ideal V/F plan subject to information on the enrolment machine unclear circuit cut-off points and given weight qualities. The modelling have done based on V/F speed control strategy and have performed beguilement's of PWM age and six heartbeat inverter yield and moreover assessed the circuit.

4.1 Case 1

At first supply can be given to the circuit is 230v. The transformer is used to give power to the driver circuit. Arduino is used to control the whole circuits control switches are used to the varying voltage and speed. Tachometer is used to measure of speed. The multi-meter is used to the measure of voltage that shown in Figure 5.

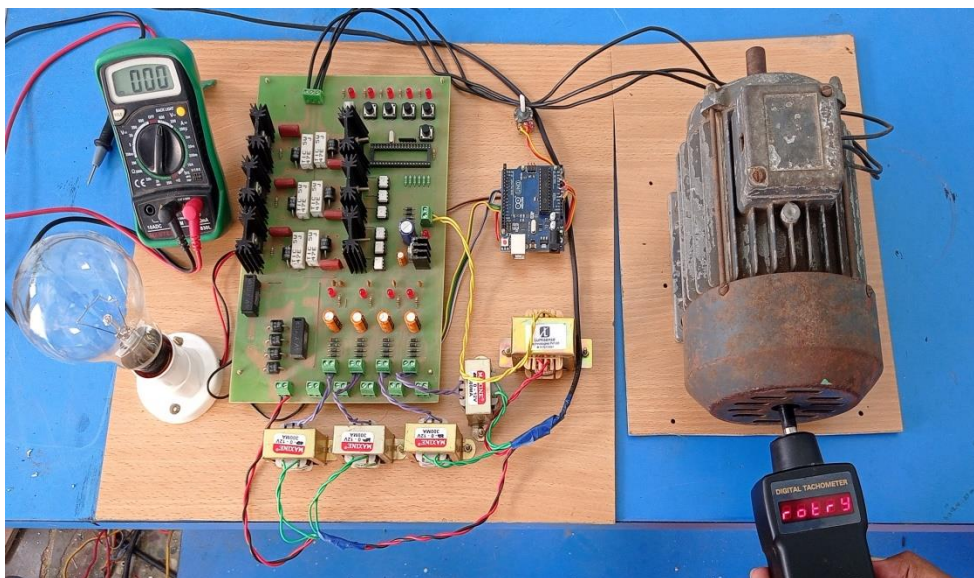


Figure 5. 3 phase induction motor at OFF state

4.2 Case 2

Varying switch can be used to control the speed and voltage from the MOSFET from these

program can be implemented into the Arduino board it can control over all speed and voltage from the fig 4.2 varying switch is reduced the motor runs at low speed and voltage also reduced as shown in Figure 6.

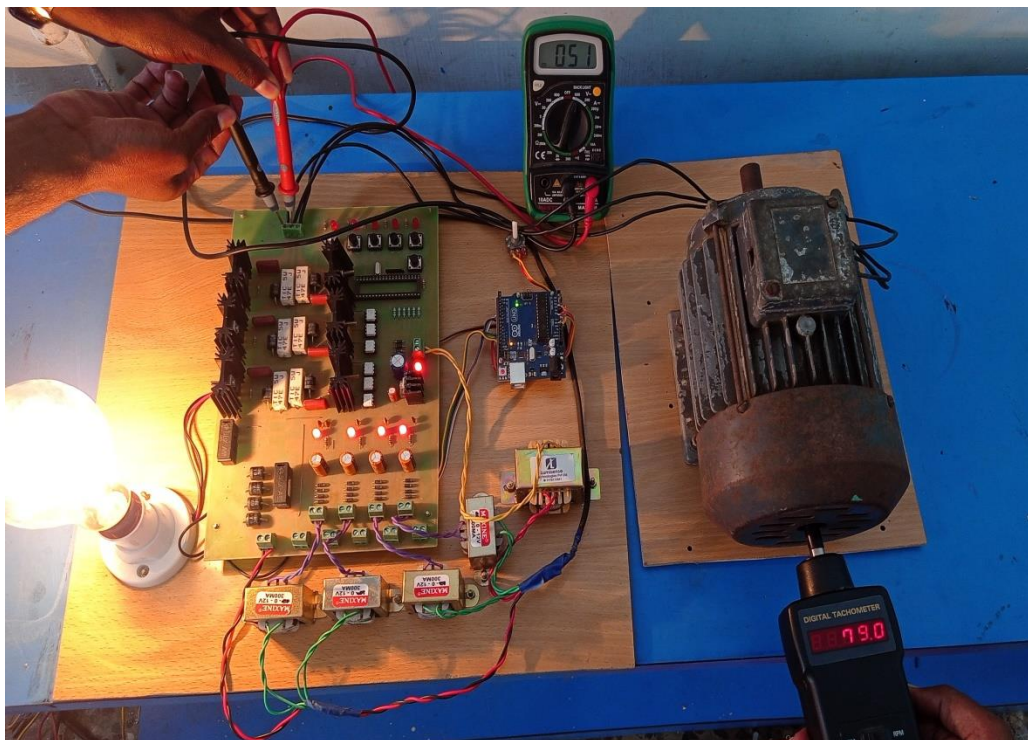


Figure 6. Working condition with low speed

4.3 Case 3

Varying switch can be used to control the motor speed and voltage from the MOSFET from these program implemented into the Arduino board it can control over all speed and voltage from the fig.4.3 varying switch is reduce the motor runs at medium speed and voltage also medium that has been shown in Figure 7.

4.4 Case 4

Varying switch can be used to control the motor speed voltage from the MOSFET from these program can be implemented into the Arduino board it can control over all speed and voltage from the fig.4.4 varying switch is reduced the motor runs at high speed and voltage also high that shown in Figure 8.

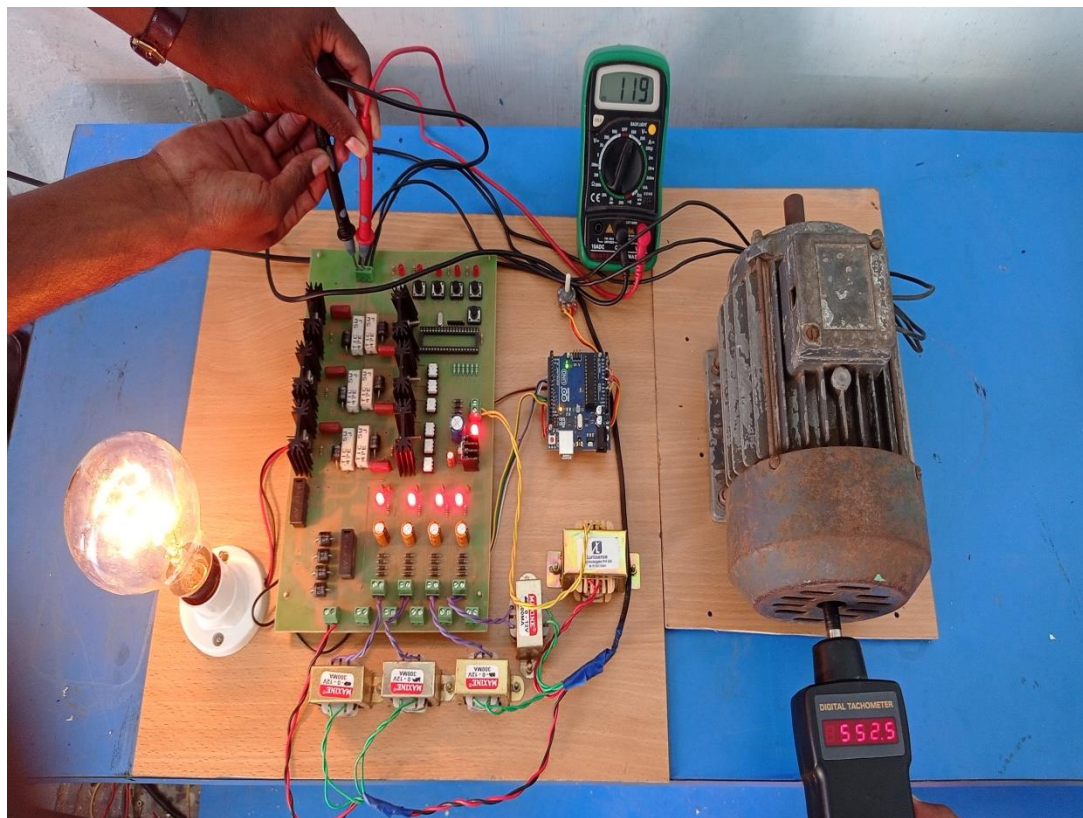


Figure 7. Working condition with medium speed

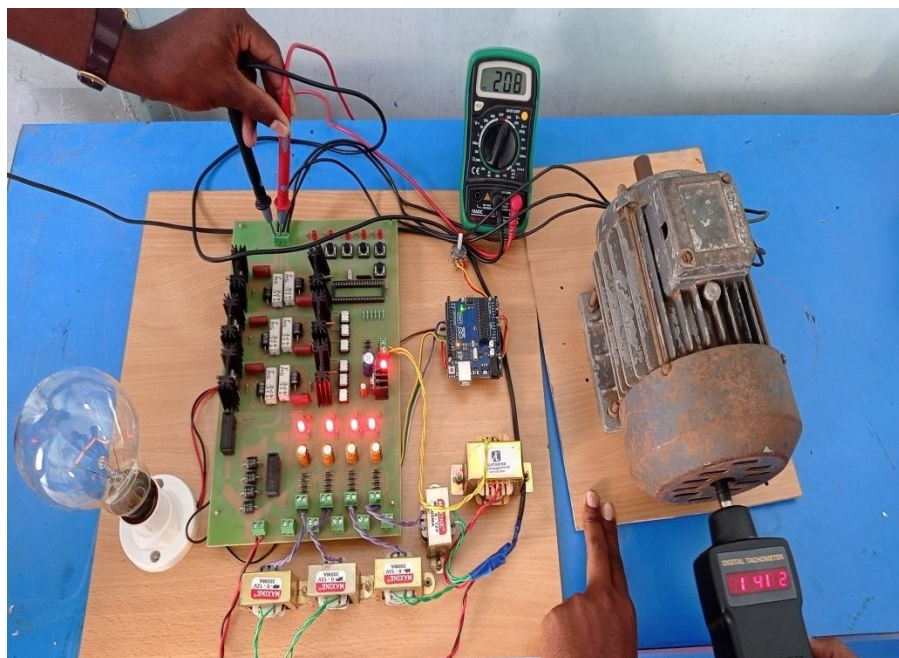


Figure 8. Working condition with high speed

5 Conclusion

According to the results of open-circuit V/F control was completed in gear viably. It have been seen by changing of reserve nominal voltage in that range of V/F extent as in the past, progress conveyed the stator continuedforeseeable. Thusly, the most limit power of the motor continued steady through the speed limit. In future this structure can be made to run most limit stage motors it might be by and large used for higher ventures, for control the motor speed according to machine set in the organizations. Voltagecan be used in to run the most limit stage motor. Speed can be changed at any stage.

Bibliography

1. OmkarGawade, OnkarUtekar, SwapnilRanjane, Ashish Raut, RekhaSonune, "V/F Speed Control Technique of Three Phase Induction Motor"Vol.4, No. 8 June 2019.
2. Neelashetty Kashappa1 and Ramesh Reddy K.2, "Performance of voltage source multilevel inverter - fed induction motor drive using Simulink"Vol.5,no. 9 may 2011.
3. DevrajJeeNikhar Patel," V/f control of induction motor drive" 2013.
4. Aparna Sharma, Asst. Prof.Abhijeet Singh, Prof. P. Yadav , "Analysis of 3 Level SVPWM based Open Loop and Closed Loop V/F Control of Induction Motor" 2015.
5. P. Elangovan, Nalin Kant Mohanty , "FPGA Based V/f Control of Phase Induction Motor Drives Integrating Super-Lift Luo Converter"Vol.2 no.12 2015.
6. Mineo Tsuji , Xiaodan Zhao, He Zhang, "New Simplified V/f Control of Induction Motor for Precise Speed Operation"Vol.4 no2011.
7. Chimezie O. Adiuku , Abdul RahimanBeig "Sensor-less Closed Loop V/f Control of Medium Voltage High Power Induction Motor with Synchronized Space-Vector PWM"2015.
8. Bin Chen Wenxi Yao Zhengyu Lu, "A Novel Stator-Flux Oriented V/f Control Method in Sensorless Induction Motor Drives for Accuracy Improvement and Oscillation Suppression"2015.
9. Puja Talukder, Prashant Kumar Soori , "Speed Control Of Induction motor Drive Using Universal-Controller"2012.
10. - AungZawLatt, Ni Ni Win, " Variable speed drive of single phase induction motor using frequency control method"2009.
11. Dr. P.S. Bimbhra, "Electrical Machinery" ,7th Edition, Khanna Publishers, New Delhi, 2010.
12. Gopal K. Dubey, "Fundamentals of Electrical Drives" ,2nd Edition, Narosa Publishing House, New Delhi, 2011.
13. M.C. Trigg and C.V. Nayar, "Matlab Simulink Modelling of a Single-Phase Voltage Controlled

Voltage Source Inverter”, Dept. of Electrical Motorering, Curtin University of Technology.

14. M HarshaVardhan Reddy and V. Jegathesan, “Open loop V/f Control of Induction Motor based on hybrid PWM with Reduced Torque Ripple”, ICETECT 2011, Karunya University.
15. Sharad S. Patil, R.M. Holmukhe, P.S. Chaudhari, “Steady State Analysis of PWM inverter fed Cage Induction Motor Drive”, Department of Electrical Motorering, College of Motorering, Pune, India.
16. NeelashettyKashappa and Ramesh Reddy K., “Performance of Voltage Source Multilevel Inverter-fed Induction Motor Drive using Simulink”, ARPN Journal of Motorering and Applied Sciences, vol. 6, No. 6, June 2011.
17. A. E. Fitzgerald, Charles Kingsley, Jr. And Stephan D. Umans, “Electrical Machinery”, McGrawHills Publications, Year 2002.
18. Scott Wade, Matthew W. Dunnigan, and Barry W. Williams, “Modelling and Simulation of Induction Machine Vector Control with Rotor Resistance Identification”, IEEE transactions on power electronics, vol. 12, no. 3, may 1997
19. TAYADE, ROHIT D., and SHRIKANT S. MOPARI. "COMPARATIVE ANALYSIS OF INTERLEAVED BOOST CONVERTER AND CUK CONVERTER FOR SOLAR POWERED BLDC MOTOR." *International Journal of Electrical and Electronics Engineering (IJEEE)* 6.4, Jun - Jul 2017, 1-12
20. Narayan, H. A. R. S. H. A. D., and R. I. J. H. I. Dey. "A Heartbeat Detection Method Based On Iot And Monitoring System Using Arduino Uno And Thing-Speak." *Methods* 9 (2018): 12. *International Journal of Electronics, Communication & Instrumentation Engineering Research and Development (IJECIERD)* 8.3, Aug 2018, 11-16
21. Murty, A., M. Satyanarayana, and I. Devi. "Compressor Health Monitoring using IOT." *International Journal of Mechanical and Production Engineering Research and Development* 8.3 (2019): 117-124.
22. HRA, SANDES H. KUMAR MIS, PRATIBHA TIWARI, and NAVNEET KUMAR MISHRA. "COMPARATIVE ANALYSIS OF THREE-PHASE INDUCTION MOTOR FED FROM BALANCED AND UNBALANCED POWER SUPPLY." *International Journal of Electrical and Electronics Engineering Research (IJEEER)* 4.2, Apr 2014, 349-356
23. Ali, SYED YASSER, and K. Suneeta. "Simulation of the hysteresis voltage control technique in the pv based dynamic voltage restorer for power quality improvement with induction motor drive." *International Journal of Electrical and Electronics Engineering Research (IJEEER)* 5.1 (2015): 95-106.