Buck Converter Duty Cycle Variation for Electric Motor Speed Control

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Abstract

In this paper, the speed of an induction motor was operated using the duty cycle of a TRIAC at a lower cost. The 1Φ and 3Φ induction motors have the same characteristics. Since the 1Φ supply is readily available, we are using 1 Φ induction motor, which is not self-starting. Here in this paper, by varying the duty cycle of the TRIAC, I.M is being controlled. Induction motor torque is proportional to the square of the voltage. The regulating parameter in this case is voltage. Raspberry Pi is a microcontroller development board that functions as a laptop replacement. Triac and gate pulses power the induction motor voltage at the stator terminals. By slightly delaying the gate pulses, we can reduce the voltage applied to the induction motor stator terminals. As torque decreases, the motor's speed decreases as well. Python is the programming language used. LINUX is also used.

Keywords*: - Linux, Buck converter, Induction motor, Python, Raspberry Pi, , TRIAC*

INTRODUCTION

Computers have become increasingly affordable over the years, and users can now find them not only underneath their desks, but also in almost any consumer electronics product, such as smart phones and DVD players. Computers aren't inexpensive, so users don't buy them on the spur of the moment when they go grocery shopping. In the future, computers like the Raspberry Pi will totally change the scenario. The Raspberry Pi, or Pi for short, is a full-fledged workstation PC that costs about $35.

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Clients can easily link it to the Internet, and it can display high-quality recordings. Furthermore, since it runs on Linux, the client does not have to pay for a working framework. As a result, the Pi is likely to be the first throwaway device in history [1]. The Raspberry Pi was created in order to teach students how to programme. As a result, the Raspberry Pi is an outstanding computer for this reason. Apart from that, the Pi may be used for a variety of purposes. Engineers may use it to play sports, and it is relatively inexpensive.

Unlike several other common microcontroller boards, the Pi can be programmed in a variety of languages and used for student projects. (#13)

Raspberry Pi is a microcontroller development board that functions as a PC replacement. In reality, it's becoming more and more like the exposed innards of a mobile phone, with manufacturer cordial headers for the various ports and capacities. The following diagram depicts all of the board's components, as defined below.

LITERATURE REVIEW

Processor-At the core of the Raspberry Pi is a similar processor that would have found in the iPhone 3G and the Kindle 2, so Raspberry Pi as practically identical to those ground-breaking little gadgets. This chip is 32 bit, 700 MHz System on a Chip, which is based on ARM11 design. An ARM chip arrives in an assortment of engineering with various centers designed to give diverse capacities at the distinctive value focuses. The Model B has 512MB of RAM and the Model A has 256 MB [3].

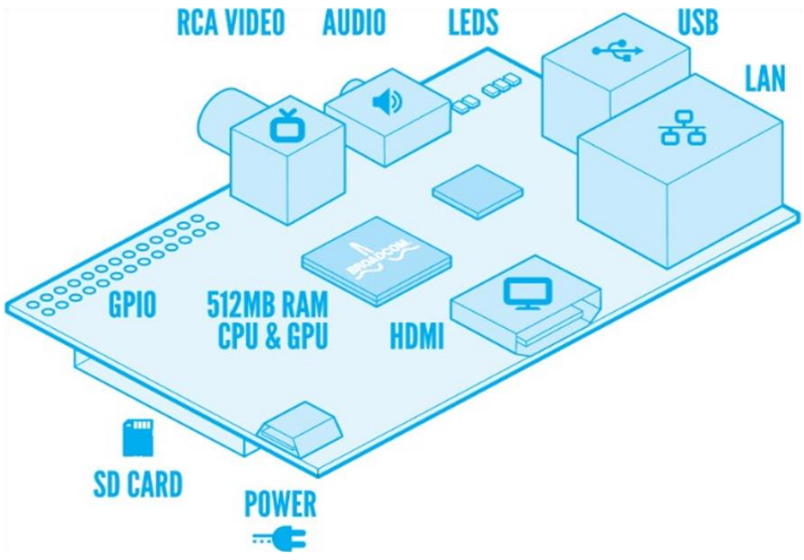


Fig: 1.The Board Configuration

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Linux- Preparing the hardware and installing an operating system are important, but its way more fun to actually boot the Raspberry Pi and see what it's capable of. So, insert the SD card with installed operating system. Linux is only a working framework bit, which implies that it handles all the low-level bits, for example, taking care of gadget drivers, and giving simple access to systems and hard circles. What really makes the Linux usable is the product which is folded over it.

Single Phase Induction Motor

There are most likely more 1 ΦAC enlistment engines being used today than the aggregate of the various sorts. It is legitimate that the slightest costly, least upkeep type engine ought to be utilized frequently The1 Φ AC induction motor best fitted tothis description. As the name suggests, this type of motor has only one stator winding and operate with a 1 Φ power supply. In all 1 Φ induction motors rotor is squirrel cage type.

All good secret agents know that user needs to be able to detect and be alerted to intruders in user's secret hideout. So this makes it the perfect time to introduce user to the Raspberry sPi! The Raspberry sPi is a combination spy camera and alerting system, the perfect solution for spotting dastardly intruders into user's inner sanctum or for monitoring user's pets over the Internet. The basic concept here is that we will be configuring our Raspberry Pi.



Fig: 2. Photograph of Spy

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Some of advantages of Raspberry Pi

Low cost

Raspberry Pi Computer is very less than conventional computers. Now it will help to have awareness about computer everywhere as its cost is low one can buy it easily.

Small size

The Raspberry Pi is a small device coming in size less than that of mobile phone. This is perfect for home automation where small device can be placed in a case and mounted inside an electrical box or replace an existing thermostat device on a wall.

High Definition Multi-media Interface

The High Definition Multimedia Interface port enables Raspberry Pi to be snared to superior quality TV and screens that help the innovation. This makes an extra choice to composite RCA port for video and moreover underpins sound. Client wishes to stream video and sound from the web to the client's TV. This port client would need to utilize [8].

Low power

It consumes low power. It requires only 5V and nearby 700mA current. This is very less comparing with other computers.

Initially all the peripheral devices are connected as explained earlier to make the set up. The GUI is created in the Raspberry Pi circuit with the help of class app which is displayed on the screen in. This GUI is used for monitoring and controlling the parameters of the load (i.e. induction motor) for which speed is to be controlled. The screen attached with the Raspberry Pi to monitor the hardware. The switches are adjusted to a particular sequence as per requirement of our parameters. Thus the hardware will respond for the speed through the proper switching.

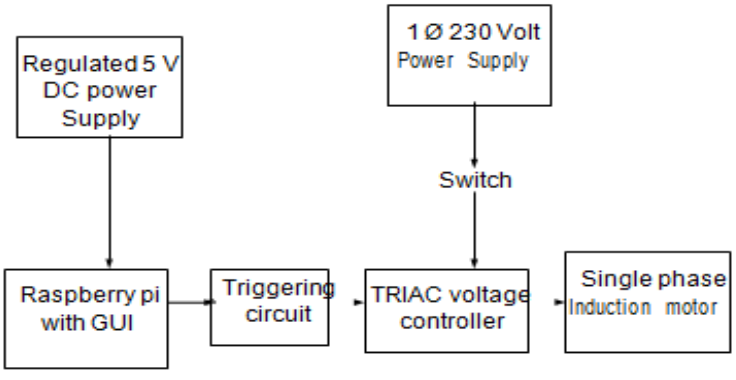


Fig: 3. Block Diagram of Hardware

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The GPIO of the Raspberry Pi (i.e. expansion header) consist of two rows of pin which are peripheral interfacing pins which is essential to interface the Raspberry Pi with the other electronic device (MOC 3020). In this expansion header ,there are total 26 pins available out of which pin no.12(GPIO 18) is the output pin to carry the PWM signal toward the opto-coupler (MOC 3020) and pin no.6 is given to the ground for switching the triggering circuit. The pin no.12 (GPIO 18) is only one easily accessible PWM signal output pin which is sufficient to drive anything that requires control than a mere on/off function .These PWM signals in the form of square waveforms used to modulated the output of triggering circuit on the basis of its frequency and duty cycle.

From the GUI of Raspberry Pi, User needs to choose the level of obligation cycle, as needs be entryway current and terminating point of TRIAC changes. This further gives the variety in stator voltage of 1φ Induction engine. Because of the adjustments in the stator voltages to the 1φ acceptance engine, speed of the engine changes appropriately according to the condition.

EXPERIMENTAL RESULTS

A PWM signal is square waveform and is used in electronic control system to control the things like a servos position, motor speed and brightness of LED. It does this on the basis of two important parameters, i.e., frequency and duty cycle. The number of repeating cycles a waveform makes in one second is nothing but frequency. Duty cycle represent the percentage of time that the signal is high or low. The resulting average value of waveforms sets the amount of power delivered to load.

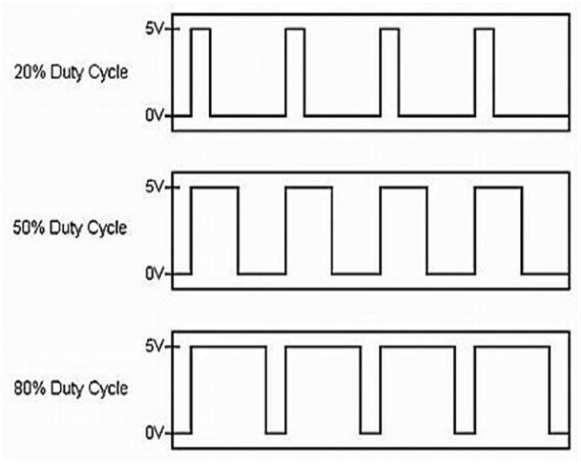


Fig: 4. PWM Waveforms

Following figure shows the PWM waveforms generated using Raspberry Pi.

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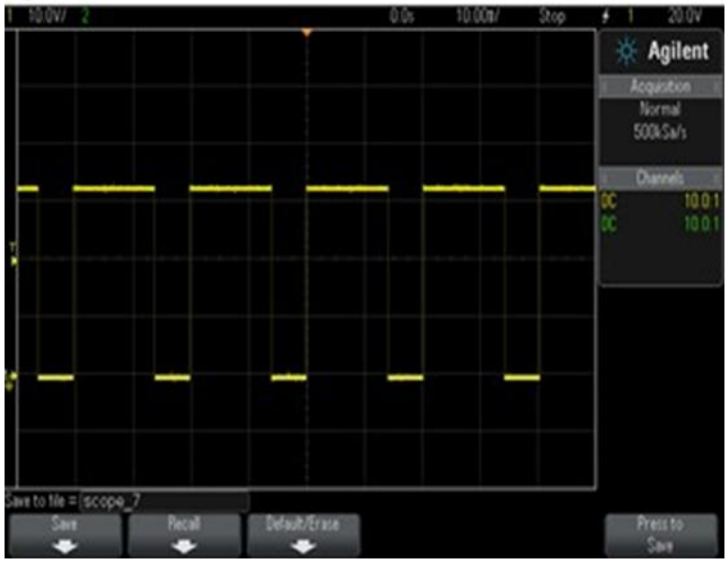


Fig: 5.70% Duty Cycle



Fig: 6.30% Duty Cycle

CONCLUSION

The main cause behind the reduction of the voltage is delay angle which can be only produced by AC voltage controllers. In this controller,triac is used as the power devices. By varying the firing pulses to triac voltage equal to the supply voltage or less than the supply voltage can be obtained. We know that when the reduced voltages are applied, the power consumed or absorbed also decreases proportionately. Hence the speed of the induction motor is reduced and also can be made equal to the

maximum values only. Upon the rate estimation of obligation cycle from the

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GPIO of Raspberry Pi, the terminating point to the triac door is controlled and along these lines the triac yield is as hacked waveform that is diminished in esteem. In this way the decreased voltage is connected to the enlistment engine and speed control is accomplished.

FUTURE SCOPE

1. Wireless speed control and remote access over the motor can be possible by using Raspberry pi. Remote tasks allow administrations, for example, long range correspondence that is unfeasible to actualize with the utilization of wire.
2. Instead of using conventional motor drive we can use automated motor drives such as Adjustable speed drive (ASD) or variable-speed drive (VSD) . It allows Smoother operation, Acceleration control, Different operating speed for each process recipe, Compensate for changing process variables, Allow slow operation for setup purpose.

REFERENCES

I. M.SyedJarnilAsghar," Smooth Speed Control of Single-phase Induction Motors by Integral-Cycle Switching", IEEE Transactions on Energy Conversion, Vol. 14, No. 4, December 1999.
II. K. Sandeep kumar, K. Pritamsatsangi," Micro-controller based closed loop control of induction motor using v/f method", iet-uk International Conference on Information and Communication Technology in Electrical Sciences (ICTES 2007), Dr. M.G.R. University, Chennai, Tamil Nadu, India. Dec. 20-22, 2007. pp.340-342.
III. Mr. Aung Zaw Latt, Dr. Ni Ni Win," Variable Speed Drive of Single Phase Induction Motor Using Frequency Control Method", 2009 International Conference on Education Technology and Computer.
IV. Divya Asija,"Speed Control of Induction Motor Using Fuzzy-PI Controller", 2010 2nd International Conference on Mechanical and Electronics Engineering (ICMEE 2010).
V. Puja Talukder, Prashant Kumar Soori, and BenettaAranjo," Speed Control of Induction Motor Drive Using Universal Controller", 2012 IEEE International Power Engineering and Optimization

Page 25-32 © MANTECH PUBLICATIONS 2021. All Rights Reserved

Conference (PEOCO2012), Melaka, Malaysia: 6-7 June 2012.

VI. AltanGencer," A Novel Microcontroller Based Speed Control Method Employing Current Controller for TWUSM", 2013 3rd International Conference on Electric Power and Energy Conversion Systems, Yildiz Technical University, Istanbul, Turkey, October 2-4, 2013.

VII. Rabisankar Roy, Susmita Das, Jayanta Kumar Ray, Shreyashi Barat, BiswarupNeogi," Automatic Speed Control of Single Phase Induction Motor with the Variation of Ambient Temperature", International Journal of Scientific and Research Publications, Volume 2, Issue 11, November 2012.

VIII. Muhammad. H. Rashid," Power electronics circuits devices and applications",3rd edition 2012.

IX. Ashfaq Husain," Electric Machines", Dhanpat Rai & Co.,2nd edition 2011.

X. http://www.raspberrypi.org

XI. https://www.electrical4u.com

XII. https://www.scribd.com/document/ 242 065212/Speed-Control-of-Single- Phase-Induction-Motor-by-Using- Triac

XIII. https://apprize.info/hardware/raspberry

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