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Space Vector Modulation Based Feed Control Using Three Phase Induction Motor

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Abstract- This paper proposes the advanced feed control technique using three phase induction motor. An SVM-based technique and a controller design strategy is presented. The system representing this controller is developed and verified victimisation MikroPro PIC. VF management victimisation the trigonometric function PWM algorithmic program could be a fashionable algorithmic program for AC induction motor control; but this algorithmic program has bound drawbacks that have an effect on the general system efficiency. An advanced switching algorithm, like space Vector Modulation (SVM), over-comes the drawbacks of the sine PWM algorithm and increases the overall system efficiency.

Keywords- Direct Torque Control, Space Vector Modulation, Induction Motor Control, Variable frequency Drive, THD(Total Harmonic distortion)

I. INTRODUCTION

In process industry controlling the material flow, fall rate is one of the prime important task. Too many techniques are used for controlling the industrial feed control like Dozing belt system, Belt drive and Table feeders. Basically most of the times DC motor drives are used for these control techniques. But now a days DC motors are replaced by induction motors due to advanced speed control techniques and low cost solutions. An induction motor can run only at its rated speed when it is connected directly to the main supply. However many applications need variable speed operations. Driving and controlling the induction motor efficiently are prime concerns in today's energy aware world. With the advancement in the semiconductor fabrication technology, each the size and the worth of semiconductors have gone down drastically. This suggests that that the motor user will replace an energy inefficient mechanical motor drive and management system with a Variable Frequency Drive (VFD). The VFD not only solely controls the motor speed, but also improves the motors dynamic and steady state characteristics as well. VF control the PWM algorithm is a common formula for AC induction motor algorithm ; but this formula has bound drawbacks that have an effect on the system efficiency. This paper given additional advanced change algorithm, like space Vector Modulation (SVM) over - comes the drawbacks of the PWM algorithm and will increase the overall system efficiency.

II. SPACE VECTOR MODULATION

The SVM is a sophisticated averaging algorithmic program that offers 15% additional voltage output compared to the PWM algorithm, thereby increasing the VDC utilization. It additionally minimizes the THD as well as switching loss. Like PWM, the SVM is also a scalar control. The direct controlled variables are the motor voltage and the motor frequency. There are various variations of SVM that result in several quality and computational needs. One active area of development is the reduction of total harmonic distortion (THD) created by the rapid switching inherent to these algorithm.

III. WHY WE USE SVM WITH EMBEDDED CONTROL

Because input VDC utilization more than PWM technique, also it gives at least 15% more output than conventional technique. This algorithm provides more advanced facilitate like vector control implementation. It also minimizes the THD as well as switching loss. The direct controlled variables are the motor voltage and the motor frequency. The 3 - phase line to neutral sine waves required for driving the 3 -phase inverter can be represented as 120° phase shifted vectors (VRn, VYn, and VBn) in space, as shown in Figure 1 For a balanced 3-phase system these vectors sum to zero**.**

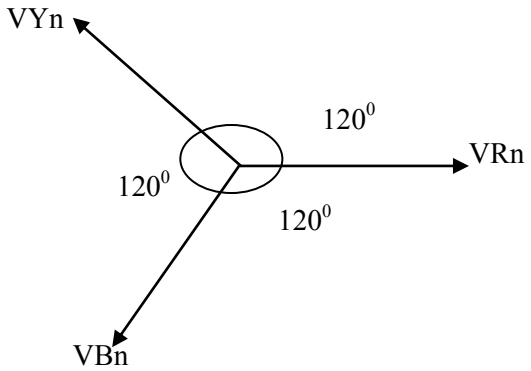


Figure 1. Balanced 3-phase vector system

Induction motor control is complex due to its non- linear characteristics. This method is most suitable for applications without position control requirements or the need for high accuracy of speed control. Examples of these applications include heating, air conditioning, fans and blowers. V/f control can be implemented by using low cost PIC microcontrollers, rather than using costly digital signal processors (DSPs). Many PIC microcontrollers have two hardware PWMs, one less than the three required to control a 3-phase induction motor. In this application note we will generate a third PWM in software, using a general purpose timer and an I/O pin resource that are readily available on the PIC microcontroller.

3.1 PIC PWM Module

The system contains the PIC18 microcontroller as main controlling device. PIC18 microcontroller is suitable for proposed system because of following reasons. The Controller Power Control PWM (PCPWM) module is a serial interface, useful for communicating with other peripherals or microcontroller devices. This module contains up to 8 output channels also having complimentary PWM outputs. It's PWM resolution up to 14 bits. Similarly this module update of duty cycle period.

3.2 Overview Of The System

The system consists of PIC18 microcontroller from PIC 8-bit family is used. PIC18 is having up to 32 Kbytes program flash memory, 10 bit ADC with up to 8 channels and Enhanced PWM module with more channels. Hardware implementation of system is as below;

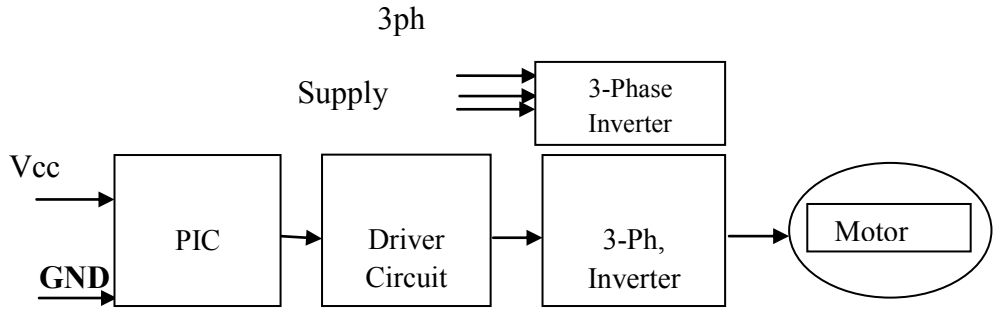
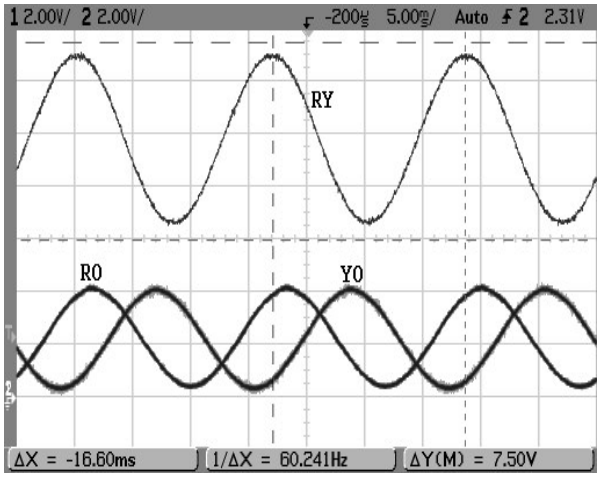


Figure 2. Architecture of proposed system

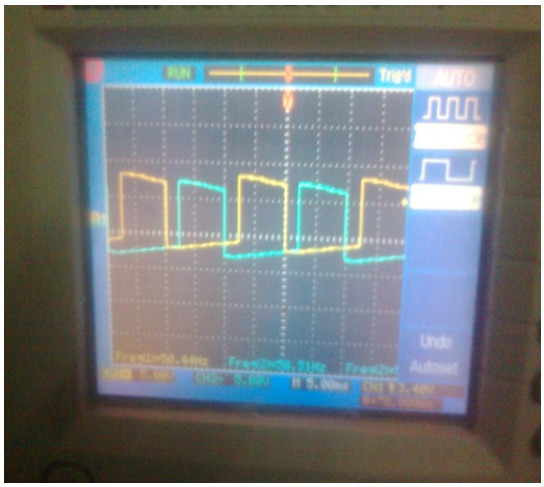
The above system consists of various blocks i.e PIC, Driver Circuit, Inverter , Bridge rectifier and 3-ph. Induction motor. PIC will generate PWM output, as per SVM algorithm .Controller sends these outputs driver circuit. Driver circuit will drive the inverter bridge circuit, then finally output fed to motor.

IV. RESULT

The SVM algorithm designed for controlling the higher speed and voltage of three phase induction motor, which is a real time application. Various ways to control the speed of induction motor but SVM is significantly improves the efficiency and having lower THD (Total harmonic distortion) SVM compared to Sine PWM in the linear operating region. The reason for the higher line-to-line voltage in SVM can be explained with the help of Figure 3. It shows the phase voltage (line-to-virtual neutral point) generated by Sine PWM and SVM. For clarity, only two phase voltages (RO and YO) and their resultant line-to-line voltage (RY) are shown in each figure. The Sine PWM generated phase voltages are sine waves. With 120° phase shift between them, the resultant line-to-line voltage is approximately 86.6% of VDC, But the SVM generated phase voltages have a third harmonic component superimposed on the fundamental component. The addition of this harmonic component is due to the effective usage of in active states which is not possible in the Sine PWM. With 120° phase shift between them, the third harmonic component is cancelled out in the resultant line to line voltage in such away that the resultant line to line voltage is boosted to VDC(100%). Thus SVM generates line-to-line voltage with higher amplitude (about 15% more) compared to Sine PWM.



A) Sine PWM Generated Waveforms



B) SVM Generated Waveform

Figure 3. Generated Phase Voltages And Corresponding Line-To-Line

As per our proposed system, now we designed and tested the PIC microcontroller circuit and driver circuit and inverter circuit.

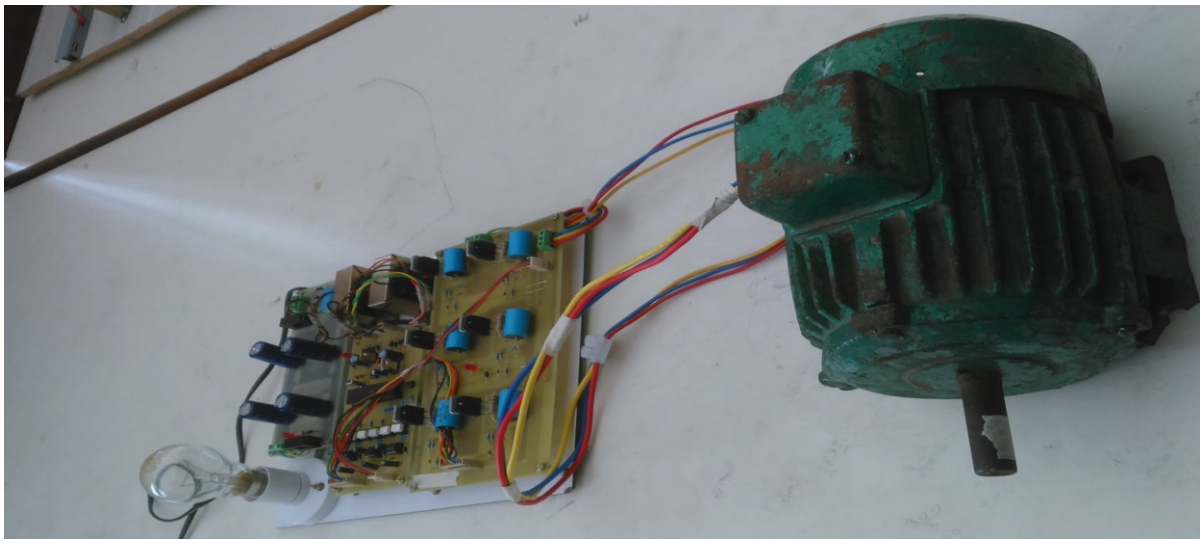


Figure 4. Actual circuit

V. CONCLUSION

This a space vector modulation technique provides efficient Speed control of motor. It gives adjacent voltage vector switching and fast dynamic response. In addition it eliminates of switching frequency variations as well as on chip resources, such as the ADC and the multiple timers, allow users to implement other control (acceleration and deceleration) an protection (over current, overvoltage, over temperature) features. Finally we can easily control the speed of table feeder.

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