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An Improved Method of Brushless DC Motors with Torque Constant Estimation for Home

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Abstract: The use of brushless dc motors is widely increasing in home appliances, military applications and various other industries due to their high power-to-volume ratio, simple structure, high efficiency and low cost. Comparing to the permanent-magnet synchronous machine, the BLDCM has higher power/weight and higher torque/current ratio. For proper commutation of the phase currents, the rotor position must be obtained with position devices. However, there are some constraints to installing position sensors to BLDCMs. These constraints include severe driving environments, cost burden, drive volume and reliability. Many sensors less control algorithms have The back EMF can be easily obtained from the voltage equation of the BLDCM. The estimated back EMF decreases simultaneously with the estimated torque constant at the commutation point. By using this phenomenon, the commutation of the phase currents can be done automatically at the drop point of the estimated torque constant. Unlike conventional back-EMF-based methods, the proposed method provides highly accurate sensor less operation even under low speeds because only the drop of the torque constant is used for position detection and current commutation. Therefore, the position accuracy is not affected by the electric parameter errors of the BLDCM. Also, this algorithm does not require an additional hardware circuit for position detection.

Key words: Brushless dc motors · Increasing in home appliances · The BLDCM has higher power · Installing position sensors

INTRODUCTION

The use of brushless dc motors (BLDCMs) is widely increasing in home appliances, military applications and various other industries due to their high power-to-volume ratio, simple structure, high efficiency and low cost Comparing to the permanent-magnet synchronous machine, the BLDCM has higher power/weight and higher torque/current ratio For proper commutation of the phase [1-3], currents, the rotor position must be obtained with position devices. However, there are some constraints to installing position sensors to BLDCMs. These constraints include severe driving environments; cost burden, drive volume and reliability Many sensor less control algorithms have been studied to control BLDCMs without rotor position sensors. categories of sensor less control algorithms are the measurement of the back electromotive force (EMF) back- [4-5] EMF integration flux estimation and freewheeling current detection. The back-EMF-sensing methods which are classified under terminal voltage sensing and the detection of the third harmonic of the back EMF [6]–[8] have both been studied. The method of terminal voltage sensing uses the zero-crossing point (ZCP) of the back EMF as a position-detecting signal. Since the back EMF is zero at standstill and is proportional to the rotor speed, it is not easy to detect the ZCP at low speed. Another method using the third harmonic of the back EMF can be implemented in a wider speed range than the terminal-voltage sensing method. However, this method requires the neutral point of the stator windings which is not usually provided by manufacturers. Also, these two methods require external hardware circuits for position detection. The back-EMF integration method extracts the rotor position by integrating the back EMF of the open phase. The integration starts at the ZCP of the back EMF and the

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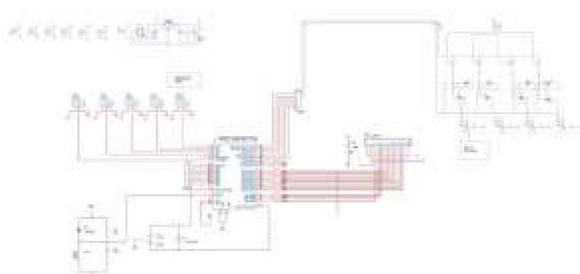
commutation is performed when the integration result reaches a preset fixed threshold voltage. This method has good performance at high speeds, but an error can be accumulated at low speeds due to the integrating operation. Another integration method using both back-EMF integration and a phase-locked loop detects the commutation point by keeping the integration results open-phase Voltage at zero. However, the terminal voltage of the open phase is distorted by the freewheeling currents and a position error occurs at high speeds and under heavy loads. The integration method of the third harmonic of the back EMF can solve these problems and has good performance at high speeds, but an additional circuit is required. The flux linkage estimation method uses measured voltages and currents for calculating the flux linkage. The position correction and estimation are obtained by using the estimated flux linkage. However, this method has an accumulated estimation error at low speeds because of a large integration time period. The freewheeling current method estimates the rotor position by using the freewheeling currents of the open phase. The ZCP of the freewheeling current is in the middle of the commutation point. However, for implementation of this method, six comparators have to be installed to detect the freewheeling currents and six isolated power sources are required for the reference signal of each comparator. The G-function method estimates the rotor position using a speed-independent flux linkage function. This method has a wide operating speed range and does not require an external hardware circuit. However, because of the pulse width modulation (PWM) switching during the.

Block Diagram



Literature Survey

Introduction: A new sensor less control algorithm for brushless dc motors (BLDCMs) is proposed in this paper. The torque constant of a BLDCM is used as a reference signal for position detection because it is constant during the entire speed range and can be estimated by calculating the ratio of the back electromotive force (EMF) to the rotor speed. By using both a disturbance observer and the torque constant estimation error, the rotor speed can be obtained. The back EMF can be easily obtained from the voltage equation of the BLDCM. The estimated back EMF decreases simultaneously with the estimated torque constant at the commutation point[4]. By using this phenomenon, the commutation of the phase currents can be done automatically at the drop point of the estimated torque constant. Unlike conventional back-EMF-based methods, the proposed method provides highly accurate sensor less operation even under low speeds because only the drop of the torque constant is used for position detection and current commutation. Therefore, the position accuracy is not affected by the electric parameter errors of the BLDCM. Also, this algorithm does not require an additional hardware circuit for position detection. The validity of the proposed algorithm is verified through several experiments.

Salient Features of the System:

- Compact.
- Low power consumption and low cost.

Requirements: In this section we present an overview on the basic requirements of the monitoring system outlining the security requirements at the end of the section.

MICROCONTROLLER-the microcontroller has on chip peripheral device. These on chip peripheral make. it possible to have single -chip microcomputer system. this is called microcontroller [5].

- Programmable code protection
- Power saving Sleep mode

Power Supply: Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones and rarely to others

A 230v, 50Hz Single phase AC power supply is given to a step down transformer to get 12v supply. This voltage is converted to DC voltage using a Bridge Rectifier. The converted pulsating DC voltage is filtered by a 2200uf capacitor and then given to 7805 voltage regulator to obtain constant 5v supply. This 5v supply is given to all the components in the circuit. A RC time constant circuit is added to discharge all the capacitors quickly. To ensure the power supply a LED is connected for indication purpose.

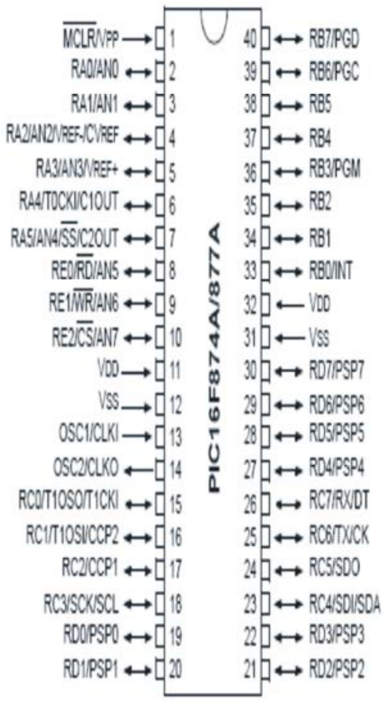


Fig. 3.1: Pin Diagram

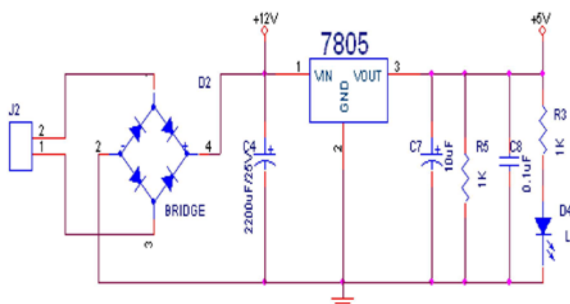


Fig. 4.1:

Bridge Rectifier: A bridge rectifier makes use of four diodes in a bridge arrangement to achieve full-wave rectification. This is a widely used configuration, both with individual diodes wired as shown and with single component bridges where the diode bridge is wired internally.

Temperature Sensor: The measurement of temperature is one of the fundamental requirements for environmental control, as well as electrical and mechanical controls. These are many different types of temperature sensors available and the type of temperature sensor that will be used in any particular application will depend on several factors. For example, cost, space constraints, durability and accuracy of the temperature sensor are all considerations that typically need to be taken into account. Various types of temperature sensors are known including liquid-in-glass (LIG) thermometers and radiometers [6]. Depending upon the temperature to be measured, the required accuracy of the measurement and other factors such as durability or cost, one type of temperature sensor may be preferable over another. Some temperature sensors provide a wide range of temperature measurement, whereas other temperature sensors may only provide temperature information for a small temperature range. In addition to the temperature range sensed, the sensitivity and the accuracy of temperature sensors may also vary widely. Additionally, some temperature sensors work at high voltages while others only work at low voltages.

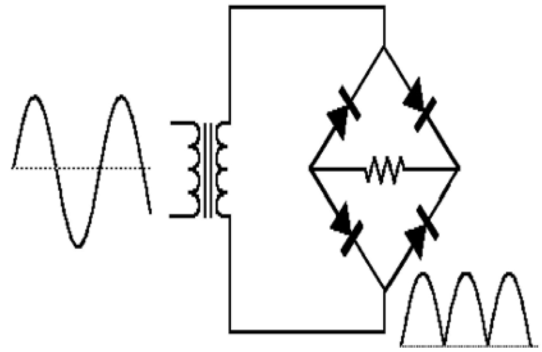


Fig. 5.1: Wave form and structural diagram

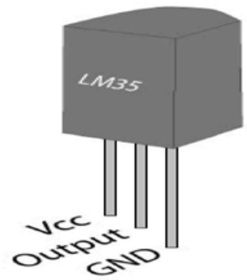


Fig. 6.2: Name of pin diagram

RESULT AND DISCUSSION

The implemented system is based on home application[7], military applications and various other industries The human thoughts is designed and they implemented,. Which derived from the human thoughts. All Wright, keep this theory in mind, as like the same concept here we implementing. Here we using temperature sensor, according to the temperature sensor here we controlling the brushless DC motor via electronic speed control. So these technologies are useful for industrial orient. Our result is showing in wave form [8].

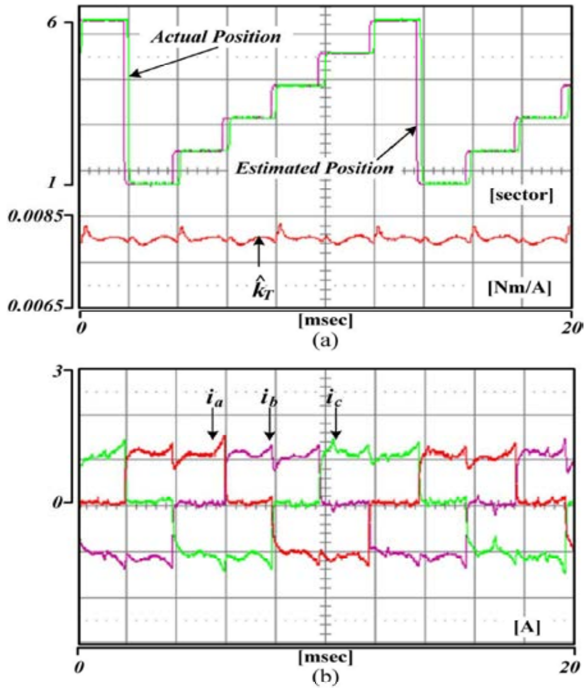


Fig. 8.1: Wave form of result

CONCLUSION

The hardware and software design of an embedded monitoring system for real time applications is presented in this paper. Vibration signals have been analyzed to detect the mechanical faults. The implementations of analysis technique in time and frequency domain are given. The proposed system imbalance detection technique is verified with different level of severity.

REFERENCES

1. Im, W.S., J.P. Kim, J.M. Kim and K.R. Baek, Jun. 2010. Torque maximization control of 3-phase BLDC motors in the high speed region, J. Power Electron., 10(6): 717-723.
2. Pillay, P. and R. Krishnan, Sep./Oct. 1991. Application characteristics of permanent magnet synchronous and brushless DC motors for servo drives, IEEE Trans. Ind. Appl., 27(5): 986-996.
3. Iizuka, K., H. Uzuhashi, M. Kano, T. Endo and K. Mohri, May 1985. Microcomputer control for sensor less brushless motor, IEEE Trans. Ind. Appl., IA-21(3): 595-601.
4. Jayalakshmi, V. and N.O. Gunasekar, 2013. Implementation of discrete PWM control scheme on Dynamic Voltage Restorer for the mitigation of voltage sag /swell, 2013 International Conference on Energy Efficient Technologies for Sustainability, ICEETS, pp: 1036-1040.
5. Uma Mageswaran, S. and N.O. Guna Sekhar, 2013. Reactive power contribution of multiple STATCOM using particle swarm optimization, International Journal of Engineering and Technology, 5(1): 122-126.
6. Arumugam, S. and S. Ramareddy, 2012. Simulation comparison of class D/ Class E inverter fed induction heating”, Journal of Electrical Engineering, 12(2): 71-76.
7. Nagarajan, C. and M. Madheswaran, 2012. Experimental study and steady state stability analysis of CLL-T series parallel resonant converter with fuzzy controller using state space analysis, Iranian Journal of Electrical and Electronic Engineering, 8(3): 259-267.
8. Ramkumar Prabhu, M., V. Reji and A. Sivabalan, 2012. Improved radiation and bandwidth of triangular and star patch antenna, Research Journal of Applied Sciences, Engineering and Technology, 4(12): 1740- 1748.