International Journal of Recent Trends in Engineering & Research
ISSN(ONLINE) : 2455-1457
IMPACT FACTOR : 3.344

SPEED CONTROL OF 3 PHASE INDUCTION MOTOR BY USING MULTIPHASE DC CONVERTER AND FOUR SWITCH INVERTER

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Abstract- The four-switch three-phase (B4) inverter, having a lower number of switches, was first presented for the possibility of reducing the inverter cost, and it became very attractive as it can be utilized in fault-tolerant control to solve the open/short-circuit fault of the six-switch three-phase (B6) inverter. However, the balance among the phase currents collapses due to the fluctuation of the two dc-link capacitor voltages; therefore, its application is limited. This paper proposes a predictive torque control (PTC) scheme for the B4 inverter-fed Induction Motor (IM) with the dc-link voltage offset suppression. The voltage vectors of the B4 inverter under the fluctuation of the two dc-link capacitor voltages are derived for precise prediction and control of the torque and stator flux. The three-phase currents are forced to stay balance by directly controlling the stator flux. The voltage offset of the two dc-link capacitors is modeled and controlled in the predictive point of view. In this proposed system the genetic algorithm is used for speed loop.
Keywords: Multiphase DC converter,Four-switch three-phase inverter, Arduino microcontroller.

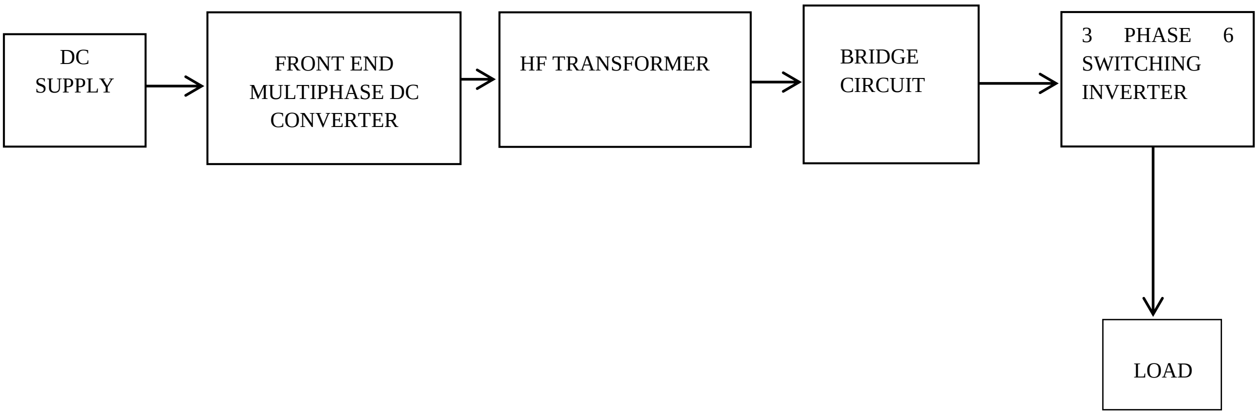
I. INTRODUCTION

In Recent years, Direct Torque Control (DTC) strategies of Induction Motor (IM) drives have been widely implemented in industrial variable speed applications. Introduced in the middle of the 1980s, the first DTC strategy involves a simple control scheme which makes it possible rapid real-time implementation. Since then, several investigations carried out in order to improve the performance of the original DTC strategy. The major focused features are the uncontrolled switching frequency of the inverter and the high torque ripple resulting from the use of flux and torque hysteresis controllers. Currently and more than two decades of investigation, several DTC strategies have been proposed so far. These could be classified within four major categories: 1) strategies considering variable hysteresis band controllers 2) strategies with space vector modulation (SVM)-based control of the switching frequency 3) strategies using predictive control schemes and 4) strategies built around intelligent control approaches. Nevertheless, the gained performance is allied to significant increase of implementation schemes. Commonly, the voltage source inverter (VSI) feeding IM under DTC is the six switch three-phase inverter (SSTPI).Some applications such as electric and hybrid propulsion systems should be as reliable as possible. Within this requirement, the reconfiguration of the SSTPI into a four-switch three phase inverter (FSTPI), in case of a switch/leg failure, is currently given an increasing attention. A DTC strategy dedicated to FSTPI-fed IM drives has been proposed. In spite of its simplicity, this strategy is penalized by the low dynamic and the high ripple of the torque. These drawbacks are due to the application of unbalanced voltage vectors to control flux and torque with a subdivision of the Clarke plane limited to four sectors. Recently, an attempt to discard the previously described disadvantages has been proposed in where a DTC scheme using a 16-sector vector selection table has been implemented.

Nevertheless, it has been noted that the drive performance remains relatively low due to the increase of the CPU time which is linked to the complexity of the involved vector selection table. In order to achieve a constant switching frequency and to decrease the torque ripple, many DTC schemes based on SVM, using the FSTPI as a VSI, dedicated to control induction and permanent-magnet synchronous motors have been reported in the literature. These strategies offer high performance in terms of torque ripple reduction allied to the control of the inverter switching losses. However, these performances are compromised by the complexity of their implementation schemes.

II. EXISTING SYSTEM

In existing system the fuzzy logic controller is used for speed estimation loop. It has following drawbacks The results are perceived as a guess, so it may be as widely trusted. It requires tuning of membership functions which is difficult to estimate. Fuzzy logic control may not scale well to large or complex problems. Fuzzy logic can be easily confused with the probability theory, and the terms used interchangeably, while they are similar concepts, they do not say the same things.



Working

The Existing system block diagram consist of following parameters are DC Supply, Front end multiphase dc converter, High Frequency transformer, Bridge circuit, Three phase six switch inverter.In multiphase dc converter, the dc supply is taken from the battery or any other dc power source for running the high power loads. The load may be three phase induction motor or any other type of motor. The Front end multiphase dc converter has 12 MOSFET switches. Each phase of the three phase supply is taken from the set of four MOSFETs and Each MOSFET has a feedback diode.The three phase taken from the multiphase dc converter is given to the high frequency transformer which has a three pair of primary and secondary windings. The high frequency transformer stepup the inverted three phase supply from the multiphase dc converter. The output terminal of the secondary of the transformers are given to the bridge rectifier.
The bridge rectifier each leg consist of two diodes and each phases given between the two diodes in the each leg. The bridge rectifier converts the pulsating dc waveform from the high frequency transformer to pure dc. The supply is given to the back end three phase six switch inverter. It has six MOSFETs and each leg has two MOSFETs. Each phases taken from the three legs of the inverter connected to the three phase load.

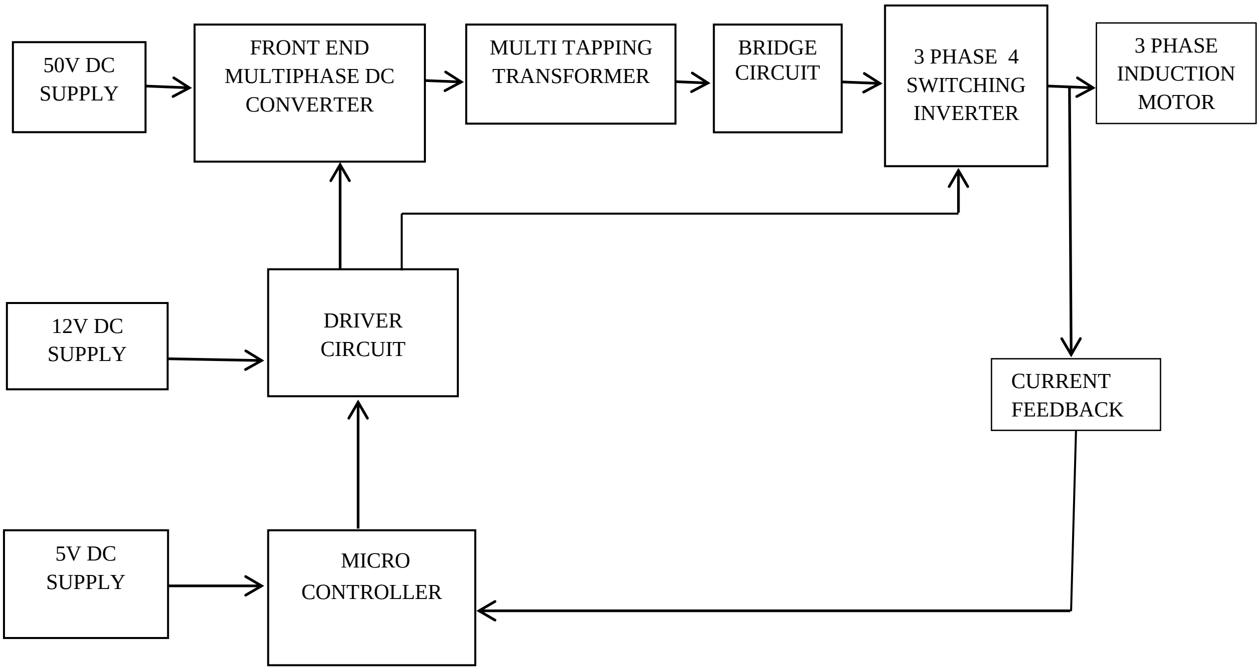
III. PROPOSED SYSTEM

In this proposed idea, the fuzzy logic is replaced by Genetic algorithm(GA). It has following merits.It can solve every optimization problem. It solves problem with multiple solutions. Genetic algorithms are easily transferred to existing simulation and models.

Genetic Algorithm

Genetic algorithms differ from the traditional approaches of existing optimization techniques. The simple ideas of the GA search have their roots in the biological processes of survival and adaptation. The basic principle of genetic algorithms consists of sampling a population of potential solutions. A population of individuals is, initially, randomly generated. The GA performs then operations of selection, crossover and mutation on the individuals, corresponding respectively to the principals of survival of the fittest, recombination of genetic material and random mutation observed in nature. The optimization process is carried out through the generation of successive populations until a stop criterion is met.To implement the genetic algorithm technique, thefollowing parameters need to be selected are population size (N),probability of crossover (pcross) (between 0.7-1.0),probability of mutation (pmut) (between 0.01-0.05).

Block Diagram of Proposed System



Working

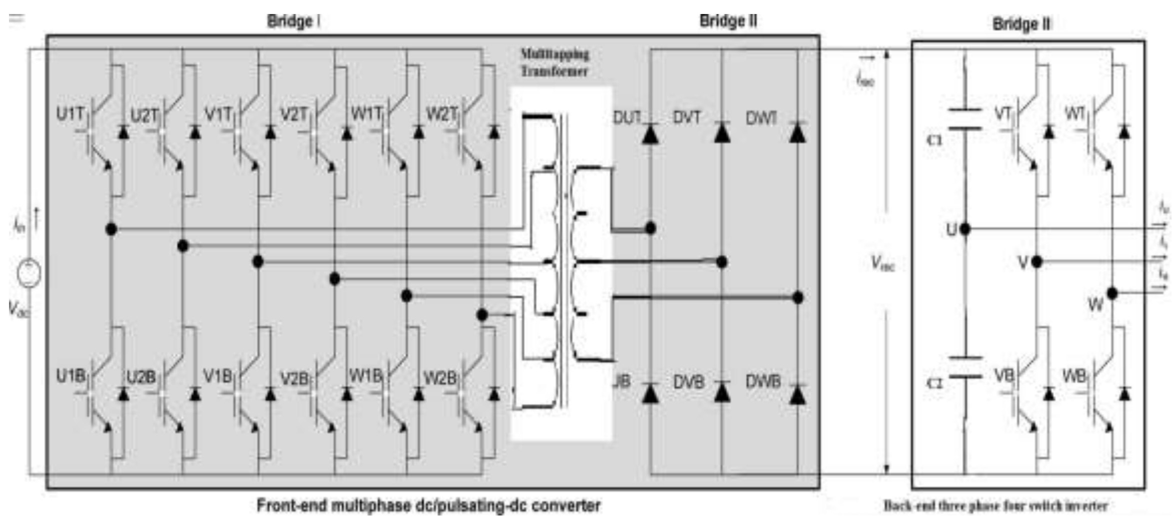
In the speed control of the three phase induction motor using the multiphase dc converter, the input supply is taken from the auto transformer. By varying the auto transformer 50v supply is fixed and given to the rectifier circuit. It converts the ac supply into dc supply. The load is the three phase induction motor.The front end multiphase dc converter has 12 MOSFET switches, Each phase of the three phase supply is taken as set of four MOSFETs. Each MOSFET has the feedback diodes. The three phase taken from the multiphase dc converter is given to the multitapping transformer which has the six tapping on the primary winding and secondary of the transformer has three windings.The multitapping transformer is to stepup the inverted three phase supply from the multiphase dc converter. The output terminal of the secondary of the transformer is given to the bridge rectifier. To convert the pulsating ac waveform into pure dc waveform with reduction in harmonics.

The supply is given to the inverter, it is back end three phase four switch inverter. It consist of four MOSFETs and two capacitor in one phase to reduce the switching losses and connected to the three phase induction motor. The output current from the three phase four switch inverter is taken as feedback and given to arduino microcontroller. Arduino controller and driver circuit is powered by 5V dc and 24V dc supply respectively from external dc source. The Microcontroller output is given to the driver circuit and driver circuit generate pulses according to the load variation. It is then given to the gate terminal of the MOSFET used in front end multiphase dc converter and three phase four switch inverter.

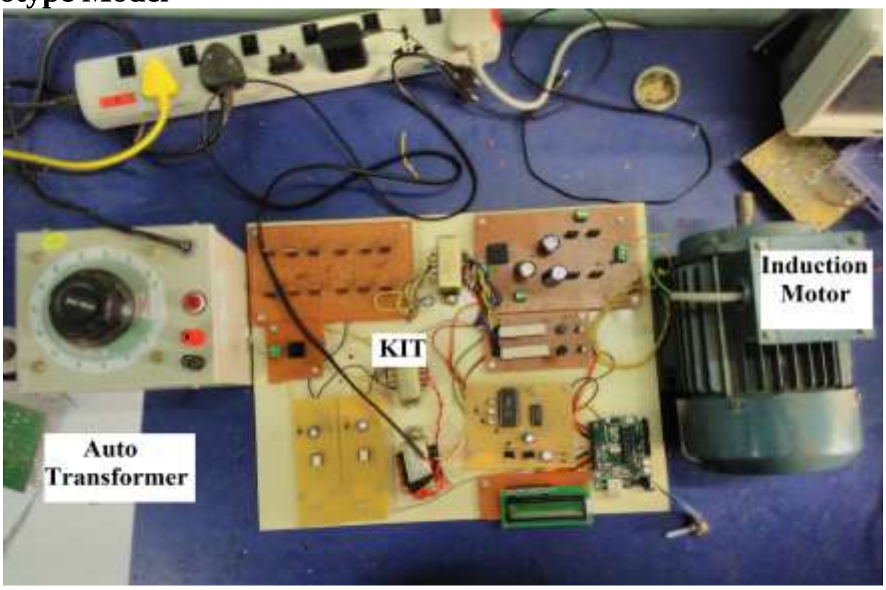
Circuit Diagram

The front-end dc/pulsating-dc converter comprises two stages of conversion is following by 1) Bridge I: three single-phase high-frequency full-bridge inverters, operating at frequency of fs , and 2) Bridge II: a three leg diode rectifier, which outputs a unipolar pulsating-dc voltage with six-pulse envelope. It is noted that,a back-end three phase four switch inverter.(Bridge III)converts this high frequency pulsating-dc voltage into a line-frequency PWM ac output. Three single-phase 1: N multitapping transformers have Y -connections at secondary side. Although the front-end multiphase dc/pulsating-dc converter has a similar structure as a fix-dc-link converter proposed in multitapping transformer, it does not require an intermediate dc-link filter and the switching schemes would be different.

The inverter is suitable for low-voltage dc to high voltage ac applications to support three-phase high watt-power loads with high power factor(Induction Motor). A typical example is an isolated three-phase or multiphase inverter used in stand-alone bulky power plant, or a fuel cell or photovoltaic panels powered grid-connected distributed generation injecting active power to the power grid. Although the diode rectifier is used as Bridge II, the inverter can support limited range of reactive loads in addition to resistive loads , up to±30◦ phase displacement is allowed for a balanced three-phase load. Other load conditions are also permitted as long as the currents flowing to Bridge III are nonnegative irec≥ 0 .The inverter can be simplified into an equivalent circuit.



Hardware Prototype Model



IV. CONCLUSION

In this paper, the special issues on using the famous PTC control scheme for a B4 inverter-fed IM drives are analyzed and discussed. The voltage vectors of the B4 inverter under the fluctuation of the two dc-link capacitor voltages are derived for precise prediction and control of the torque and stator flux. The balanced three-phase currents are achieved and the capacitor voltage offset is suppressed in the proposed scheme. The proposed B4 inverter-fed IM drive has been found acceptable for high performance industrial variable-speed-drive applications considering its cost reduction and other inherent advantageous features. We have proposed the system by replacing PI by Genetic Algorithm (GA) which increases the efficiency of the B4 inverter system.

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