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Development Of Bldc Motor-Based Elevator System Suitable For Dc Micro Grid

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ABSTRACT

Recently, several measures are being taken to conserve energy without degradation in performance. To achieve notable energy savings in elevator systems, in this paper we develop and experimentally test and Operation of an elevator can be classified into four quadrant operations. Four quadrant operation of the proposed elevator system has also been indicated with the simulation results. To demonstrate the successful working of the proposal, a prototype elevator system has been designed and developed in the laboratory.

Experiments have been conducted for the upward and downward movement of the elevator cabin with and without load. Brushless Direct Current (BLDC) motors have secured a very significant space in the modern drives industry primarily due to the added benefits of a dc input system along with a brushless drive.

Various advantages such as, high torque/current ratio, high power density and higher efficiency make these motors very suitable for replacing conventional motors in many systems. cite such advantages of a BLDC motor and also present a new simulation model that can be used for analysis and design of BLDC motors.

This prototype model consists of (i) mechanical components, such as worm gear, pulley and EC, etc., (ii) set of sensors for detecting floor position and rotor position of the motor, (iii) user command buttons, (iv) LED indicators and (v) BLDC motor along with power and control circuits.

INTRODUCTION

An elevator is a vertical transportation vehicle used mainly for the transit of people and goods in high-raised buildings. Easy and efficient transportation within a building is of utmost importance, since the present day cities are considered to grow vertically. Generally an elevator uses a three phase induction motor to carry out the hoisting operation. However, considerable research has been carried out to replace the conventional motor to attain improved efficiency, reliability and speed. Brushless Direct Current (BLDC) motors have secured a very significant space in the modern drives industry primarily due to the added benefits of a dc input system along with a brushless drive. Various advantages such as, high torque/current ratio, high power density and higher efficiency make these motors very suitable for replacing conventional motors in many systems.

An elevator system deals with numerous signals and some of those are floor position signal, load sensor signal, door open signal, alarm, floor commands etc. Thus the controller designed for the elevator system needs to efficiently organize these signals for operating the system as per the user command. Ekanayake *et al*. have emphasized this aspect and suggested how a Field Programmable Gate Array (FPGA) controller can be beneficial for operating elevator systems. Yuhang *et al*. have implemented a six layer automatic elevator controller using an FPGA, highlighting the need and advantages. Joost *et al*. have shown the advantages of an FPGA based multiprocessor system in industrial applications. Wu *et al*. have developed a direct – drive servo valve using an FPGA in the current controller and mentions why FPGA is superior over other controllers.

Thus, owing to flexibility, durability and at-site re-configurability, FPGA controllers are gaining increased importance for many industrial applications. So, in this work, an FPGA controller has been designed and developed for the proposed elevator control. Easy and efficient transportation within a building is of utmost importance, since the present day cities are considered to grow vertically. Generally an elevator uses a three phase induction motor to carry out the hoisting operation. However, considerable research has been carried out to replace the conventional motor to attain improved efficiency, reliability and speed.

Jung *et al*. have developed a nine phase permanent magnet motor drive system for an ultra-high speed elevator system and the feasibility of the drive system was tested in the world's tallest elevator test tower. Such a design is very useful to meet the need for high speed elevator operation which cannot be suitably satisfied by conventional three phase electric drive systems. Other drives like linear switched reluctance motors have also been studied for the purpose of implementation in elevator systems. A linear motor design capable of generating a magnetic field decoupled from the thrust generating magnetic field of the linear motor is presented where the decoupled field can be used to actuate a brake mechanism, forming the basis of an elevator safety system. Mutoh *et al*. have presented a controller suitable for elevators which increases the efficiency and performance of an elevator system.

Osama *et al*. have implemented and analyzed the performance of an elevator with three-phase induction motor drive and made a comparison with the traditional dual stator winding line-supplied elevator motors. Brushless Direct Current (BLDC) motors have secured a very significant space in the modern drives industry primarily due to the added benefits of a dc input system along with a brushless drive. Various advantages such as, high torque/current ratio, high power density and higher efficiency make these motors very suitable for replacing conventional motors in many systems.

Jeon *et al*. cite such advantages of a BLDC motor and also present a new simulation model that can be used for analysis and design of BLDC motors [6]. Many studies have also been carried out to obtain higher efficiency and better control for BLDC motors. Further, owing to the ease of control and scope for regenerative braking, considerable amount of research has been carried out to incorporate BLDC motors in Electric Vehicles

In the last decade, considerable developments have taken place in the design and operation of dc microgrids for effective utilization of renewable energy sources. Less power conversion stages, simple control, absence of reactive power, no harmonics, and easy to connect energy storage devices, namely, battery, plug-in electric vehicles and super capacitors are the main reasons for preferring dc microgrids with renewable energy sources. In fact, Strunz *et al*. have proposed a dc microgrid system for harnessing wind and solar energy that occur at the top of high-raised buildings. Anand *et al*. address this very issue and suggest a dc system with different optimum levels for high efficiency and reliability with low system cost.

In a similar study, Li *et al*. suggest that a dc voltage of 60 V can be selected as standard for dc home microgrids considering various factors of efficiency, risk and equipment suitability. Commercial elevator systems employing 3-phase induction motor (IM) drive is operated from 400 V ac supply with v/f control. This requires a dc source of more than 500 V for operating the IM based elevator system. Hence if such IM based system is to be adopted with dc microgrid, then an additional power converter needs to be employed as compared to BLDC machine system. This is an added attractive feature of BLDC drive with dc microgrid application besides the advantages mentioned above. So, an attempt is made in this paper to study the operation of the BLDC motor based elevator system operated from the dc grid.

EXISTING SYSTEM:

It is known that the Brushless Direct Current (BLDC) motors have smooth speed control, high power density and fewer complexities in power converter and controller when operated with dc supply as compared to other electrical motors. Hence, this paper enunciates the scope of using BLDC motors for elevator systems suitable for operating with dc micro grid. Four quadrant operation of the proposed elevator system has also been indicated with the simulation results.

CONCLUSION:

The closed–loop control strategy can be achieved at very low speed, the start–up curve is very simple, and the hardware and software are low cost and easy adjustment. In general, the simulation results and the experimental results show that the energy savings is possible in elevator operation under variable speed algorithm. The amount of energy savings obtained in simulation is slightly different from the amount of energy savings obtained in the experiment with the model. One reason for the difference of results of simulation and the experiment may be the use of different type of energy form. In simulation, we considered the mechanical energy of the elevator system whereas in the actual experiment we measured the electrical energy. Also, the experimental model is for a Three floor building whereas the simulation model also three floor building.

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