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Elevator control using BLDC motor and renewable energy sources

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***Abstract* - In recent days, utilization of renewable energy sources has been emphasized in high-raised buildings, where dc micro grid is established. 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. For analyzing the proposed BLDC motor based elevator system, a PIC Controller model has been inserted by interfacing various electrical and mechanical components. 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 and the findings are given in the paper. Regenerative braking is also possible for the proposed system by employing a suitable gear mechanism in place of worm gear, also we can construct the power supply mechanism using Solar and wind generated energy in proposed system.**

Introduction

Lift or elevator, is a transport device that is very common to us nowadays. We use it every day to move goods or peoples vertically in a high building such as shopping center, working office, hotel and many more. It is a very useful device that moves people to the desired floor in the shortest time. This project dissertation documents the findings and results of a research on a microcontroller based lift control system. It provides information, which is useful to those who wish to carry out a lift control system research or project. In this project, PIC microcontroller is used as the primary controller. Besides, it is consist of various inputs and outputs circuits together with a lift model. The microcontroller is used to coordinate the functions of various hardware circuitries. Service request circuit or keypad and sensors are used as input. Stepper motor driver circuit, DC motor circuit, seven-segment display, buzzers and various types of LED (light emitting diodes) displays are used as output. The lift model was constructed to simulate an actual lift in the real life. It can be counted as the output hardware of the system. The software for the system was designed according to the real lift traffic management algorithm. The combination of the hardware and software perform the simulate function of a basic lift system.

Objectives

An elevator system is a vertical transport vehicle that efficiently moves People or goods between floors of a building. They are generally powered by electric Motors. The most popular elevator is the rope elevator. In the rope elevator, the car is Raised and lowered by transaction with steel rope. Elevators also have electromagnetic Brakes that engage, when the car comes to a stop. The electromagnetic actually keeps the brakes in the open position. Instead of closing them with the design, the brakes will automatically clamp shut if the elevator loses power. Elevators also have
Automatic braking systems near the top and the bottom of the elevator shaft. Many modern elevators are controlled by a computer. The computers job is to process all of the relevant information about the elevator and turn the motor
correct amount to move the elevator car in correct position. In order to do this the Computer needs to know at least three things those are

i) where people want to go
ii) where each floor is
iii) where the elevator car is

a) To design a lift control system by using microcontroller MC68HC11 A1.

b) To design the program (software) for the overall system according to the real lift traffic management algorithm.

c) To integrate the hardware and software in order to simulate the functions of a basic lift system.

d) To build a lift model to simulate the actual system.Finding out where people want to go is very easy. The buttons in the elevator car and the buttons in each floor are all wired to the computer, when anyone Presses these buttons, the computer logs this request.

History of Elevator

Elevators began as simple rope or chain hoists. An elevator is essentially a platform that is either pulled or pushed up by a mechanical means. A modern day elevator consists of a cab (also called a "cage" or "car") mounted on a platform within an enclosed space called a shaft or more correctly a hoist way. In the past elevator drive mechanisms were powered by steam and water hydraulic pistons. (Wikipedia, 2 August 2005) 4 during the middle ages, the elevator operated by animal and human power or by water-driven mechanisms. The elevator as we know it today was first developed during the 1800s and relied on steam or hydraulic plungers for lifting capability. In the latter application, the cab was affixed to a hollow plunger that lowered into an underground cylinder. Liquid, most commonly water, was injected into the cylinder to create pressure and make the plunger elevate the cab, which would simply lower by gravity as the water was removed. Valves governing the water flow were manipulated by passengers using ropes running through the cab, a system later enhanced with the incorporation of lever controls and pilot valves to regulate cab speed. The granddaddy of today's traction elevators first appeared during the 19th century in the United Kingdom, a lift using a rope running through a pulley and a counterweight tracking along the shaft wall. (Elevator Info, 1992) In the 1800s, with the advent of electricity, the electric motor was integrated into elevator technology by German inventor Werner von Siemens. With the motor mounted at the bottom of the cab, this design employed a gearing scheme to climb shaft walls fitted with racks. By 1903, this design had evolved into the gearless traction electric elevator, allowing hundred-plus story buildings to become possible and forever changing the urban landscape. Multi-speed motors replaced the original single-speed models to help with landing-leveling and smoother overall operation. Electromagnet technology replaced manual rope-driven switching and braking. Besides, Push-button controls and various complex signal systems modernized the elevator even further. Safety improvements have been continual, including a notable development by Charles Otis. (Charles Otis, 1996).

Microcontroller:

PIC is a family of microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to Peripheral Interface Controller. The first parts of the family were available in 1976; by 2013 the company had shipped more than twelve billion individual parts, used in a wide variety of embedded systems.
Early models of PIC had read-only memory (ROM) or field-programmable EPROM for program storage, some with provision for erasing memory. All current models use Flash memory for program storage, and newer models allow the PIC to reprogram itself. Program memory and data memory are separated. Data memory is 8-bit, 16-bit, and, in latest models, 32-bit wide. Program instructions vary in bit-count by family of PIC, and may be 12, 14, 16, or 24 bits long. The instruction set also varies by model, with more powerful chips adding instructions for digital signal processing functions.
The hardware capabilities of PIC devices range from 8-pin DIP chips up to 100-pin SMD chips, with discrete I/O pins, ADC and DAC modules, and communications ports such as UART, I2C, CAN, and even USB. Low-power and high-speed variations exist for many types.
The manufacturer supplies computer software for development known as MPLAB, assemblers and C/C++ compilers, and programmer/debugger hardware under the MPLAB and PICKit series. Third party and some open-source tools are also available. Some parts have in-circuit programming capability; low-cost development programmers are available as well has high-production programmers.
PIC devices are popular with both industrial developers and hobbyists due to their low cost, wide availability, large user base, extensive collection of application notes, and availability of low cost or free development tools, serial programming, and re-programmable Flash-memory capability.

Advantages of Pic Controller:

1.Small instruction set to learn RISC architecture
Built-in oscillator with selectable speeds.
2.Easy entry level, in-circuit programming plus in-circuit debugging PICkit units available for less than $50.
3.Inexpensive microcontrollers.

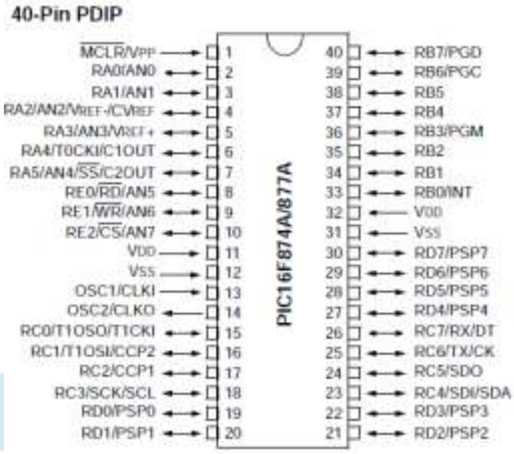


Fig.Pin Diagram

Elevator Simulator

A pre-built elevator simulator is available for each student team. The simulator contains 3 floors and a 12-volt DC hoist motor for the car. There is an IR transmitter/receiver at each floor to detect the position of the car. The receiver output is connected to the base of a BJT and the emitter functions as the detector output. The IR detection system is designed for 24 volts, but it will function properly at lower voltages. Three hardware pushbuttons are used as the floor call pushbuttons. Some of the elevators are equipped with the pushbuttons, while others require students to connect them externally. Terminal strips are provided for I/O connections. The picture of the elevator simulator is shown below in Figure.

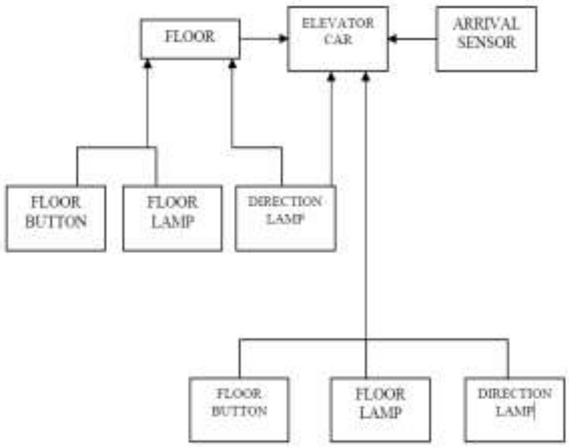
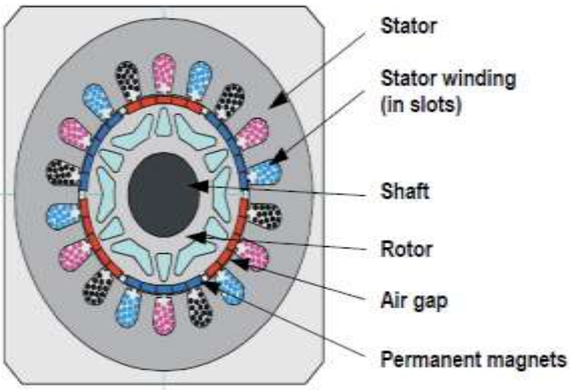


Fig.(4.2) Elevator System Overview

Brushless DC (BLDC) Motor:

A BLDC motor accomplishes commutation electronically using rotor position feedback to determine when to switch the current. The structure is shown in Figure 9(b). Feedback usually entails an attached Hall sensor or a rotary encoder. The stator windings work in conjunction with permanent magnets on the rotor to generate a nearly uniform flux density in the air gap. This permits the stator coils to be driven by a constant DC voltage (hence the name brushless DC), which simply switches from one stator coil to the next to generate an AC voltage waveform with a trapezoidal shape.



Fig(4.3) Cross Section Of BLDC Motor

VOLTAGE Regulator:

This is the basic L7805 voltage regulator, a three-terminal positive regulator with a 5V fixed output voltage. This fixed regulator provides a local regulation, internal current limiting, thermal shut-down control, and safe area protection for your project. Each one of these voltage regulators can output a max current of 1.5A.

Features:

Output Voltage: 5V

Output Current: 1.5A

Thermal Overload Protection

Short Circuit Protection

Output Transition SOA Protection

LCD Display

FEATURES

 5 x 8 dots with cursor

 Built-in controller (KS 0066 or Equivalent)

 + 5V power supply (Also available for + 3V)

 1/16 duty cycle

 B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED)

 N.V. optional for + 3V power supply

The LCDs have a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display. The interface consists of the following pins: register select (RS) pin that controls where in the LCD's memory you're writing data to. You can select either the data register, which holds what goes on the screen, or an instruction register, which is where the LCD's controller looks for instructions on what to do next.

Figures

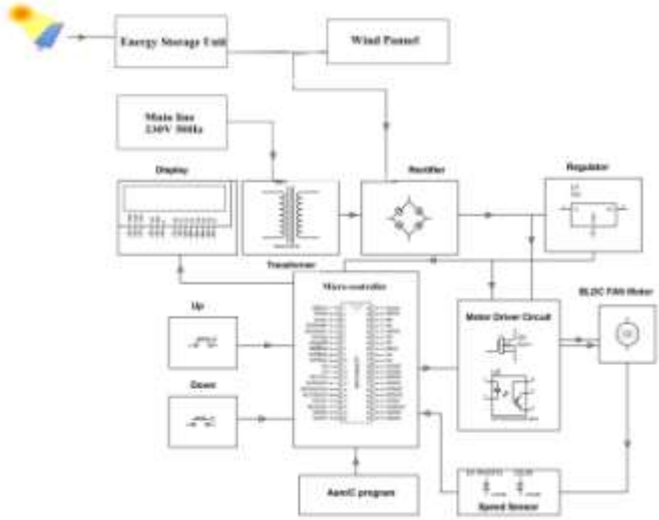


Fig. Block diagram of Elevator Control

CONCLUSION

For applications with slow response characteristics, such as this elevator control system project, utilization of a PC-based data acquisition system with Lab view provided an effective alternative to a PLC-based control system. Most of the student teams were able to complete all of the engineering requirements. However, less than ½ of the teams submitted all of their work on time. Student comments about the project were mixed, but 100% of the students either agreed or strongly agreed with being able to design and implement an elevator control system. Since this is the first time the project was used in the course, additional student feedback will need to be assessed to determine the overall effectiveness of the project, while considering the overall scope of the project and the project completion length. Additionally, this project effectively integrates both hardware and software design concepts covered from many prerequisite courses. The project can be used to assess both ABET general criteria and program-specific ECET outcomes.

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