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DEVELOPMENT OF A CONTROL SYSTEM FOR INDUSTRIAL ELEVATOR USING PLC

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Abstract: *Control system is the synergistic combination of mechanical engineering, electronic engineering, control engineering, computer engineering to create useful product or system. This is the paper about controlling an industrial elevator or lift by using PLC control system. In the industry some task that are beyond human capabilities, such as handling too heavy loads, too large objects that's are carrying by the elevator. Generally in industry or building all commercial elevators operate automatically and the computer age has brought the microchip-based capability to operate vast banks of elevators. If the elevators are control by PLC then more accurate result can be found. The program can be changed without any change of circuit. Here we developed a demo elevator which is controlling by PLC control system. The PLC used is LG Master-k80s with 8 inputs and 8 outputs. The design incorporates an intelligent controller that services all the requests in an energy-saving way, rather than on a first-come, first-served basis. Some suggestions on how to extend this system to the control of three floors are also included. Here studies have been done about control system, types of elevator, control system of micro controller, control system of PLC, the way of developing and proposing a new system. The paper also gives an idea about control system in lift which will be benefited for building in our country.*

Keywords: Control system, PLC, Microcontroller, Industrial elevator, Project Design.

1. INTRODUCTION

Programmable logic controller is a computer based controller that uses inputs to monitor a process/machine (e.g., input from a sensor) or to get switching command (e.g., input from a push switch or toggle switch) and uses outputs to control that process/machine according to the program (instruction) stored in the controller. They are capable of storing instructions, such as, sequencing, timing, counting, arithmetic operation, data manipulation and communication to control industrial machines and processes [2]. Programs are entered into the PLC memory using a programming device that is usually not permanently connected to a particular PLC, and can be moved from one PLC to the next without disturbing the operations. It allows the user to enter, edit and monitor programs by connecting into the processor unit allowing access to the user memory. Programming device can be a hand-held device or a personal computer. A personal computer with appropriate software can act as a programming terminal. When the program has been designed on the programming device and is ready, it is transferred to the memory unit of PLC. PLC can handle one program in memory at a time and can handle input and output terminals - each terminal on input and output modules is assigned a unique address number. This address is used by the microprocessor to identify the location of the device in order to monitor or control it. These addresses can be represented in decimal, octal or hexadecimal terms depending upon the number system used by PLC [2].

Figure-1 illustrates a conceptual diagram of a PLC application.

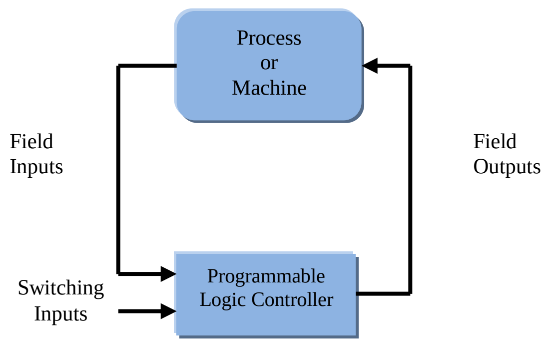

Figure-1: PLC application design [2].

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2. PLC AS A SYSTEM CONTROLLER

A PLC is a microprocessor-based control system, designed for automation processes in industrial environments. It uses a programmable memory for the internal storage of user-orientated instructions for implementing specific functions such as arithmetic, counting, logic, sequencing, and timing. A PLC can be programmed to sense, activate, and control industrial equipment and, therefore, incorporates a number of I/O points, which allow electrical signals to be interfaced. Input devices and output devices of the process are connected to the PLC and the control program is entered into the PLC memory [8]. Simple PLC system block diagram to detail architecture are shown in the following figures

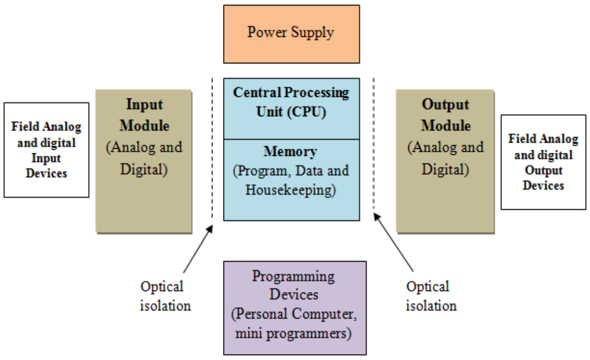

Figure-2: Simple PLC system.

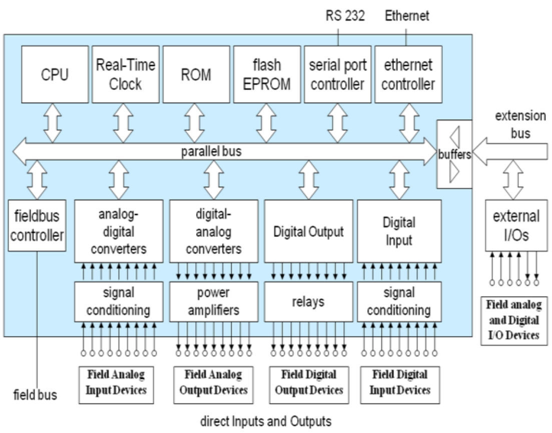

Figure-3: General PLC architecture [3].

3. CONTROL SYSTEM OF THE ELEVATOR

In this application we will be controlling an industrial elevator with 3 floors. The program will control various phases of the elevator motion. Initially the elevator will be on the 2nd floor. From there we will need to wait for a passenger to enter the car and press one of the buttons or someone will press one of the wall buttons on the other floors. Once one of the buttons is pressed the elevator will proceed to the floor that called it. The elevator uses two separate motors, one to go up and another to go down. There are also three sensors that let the system know that it has arrived at one of the floors. The car has 3 buttons

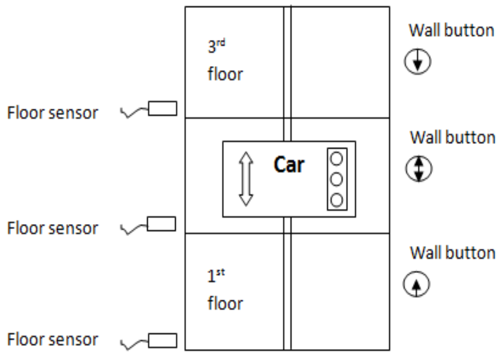

Figure-4: Schematic view of the Industrial Elevator

for the passenger to press and take the car to the appropriate floor. We should also note that depending upon the floor the car is currently on it can move in only one or both directions. In other words, if the car is on the 1st floor it can only go up whereas if its on the 3rd floor it can only go down.

3. HARDWARE DESCRIPTION

The objective of the hardware design is to develop the interface circuit between the PLC and the elevator system and the elevator control panel, with both external and internal requests. These requests are produced by push buttons that send continuous signals to the PLC when activated. Each push button is connected to an LED to identify the request placed. In addition, the four floors are represented by four LEDs, one for each level. Furthermore, three sensor in three floor are introduce to give information to the PLC from the setup. This facility was introduced to simulate the desire for a sudden stoppage of the elevator either for reasons of safety or for requests for a repair job to be carried out on the elevator. In order to obtain the desired setup, we needed to find a way to capture the pulse generated by a depressed push button. We also needed to make sure that the PLC is recognizing these signals in order for it to correctly perform the required action. Equipment Required

1. PLC: K7M-DR20S.
2. Software: KGL_WIN for Windows Version 3.66 for PLC.
3. Compiler: mikroC PRO for PIC 2009.
4. Loader: QL-2006.
5. 220V AC main supply for PLC (internally converted to 5V DC. logical input and 24V DC for input module).
6. 24V DC Power supply for output module.
7. 12V DC supply for stepper motor.
8. 24V DC Relay (LY2).
9. Two contact relay base.
10. Push button switch.
11. Three LDR sensor.
12. RS-232 Connector.
13. 12V-24V DC 2-phase stepper motor (1.8^{0}/step).
14. Steeper motor driver circuit with PIC16F72 Microcontroller

4. SOFTWARE DESCRIPTION

PLC's programming is based on the logic demands of input devices and the programs implemented are predominantly logical rather than numerical computational algorithms. Most of the programmed operations work on a straightforward two-state "on or off" basis and these alternate possibilities correspond to "true or false" (logical form) and "1 or 0" (binary form), respectively. Thus, PLCs offer a flexible programmable alternative to electrical circuit relay-based control systems built using analog devices. The programming method used is the ladder diagram method. The PLC system provides a design environment in the form of software tools running on a host computer terminal which allows ladder diagrams to be developed, verified, tested, and diagnosed. First, the high-level program is written in ladder diagrams, then the ladder diagram is converted into binary instruction codes so that they can be stored in random-access memory (RAM) or erasable programmable read-only memory (EPROM). Each successive instruction is decoded and executed by the CPU. The function of the CPU is to control the operation of memory and I/O devices and to process data according to the program. Each input and output connection point on a PLC has an address used to identify the I/O bit. The method for the direct representation of data associated with the inputs, outputs, and memory is based on the fact that the PLC memory is organized into three regions: input image memory (I), output image memory (Q), and internal memory (M) [7].

The development system comprises a host computer (PC) connected via an RS232 port to the target PLC. The host computer provides the software environment to perform file editing, storage, printing, and program operation monitoring. The process of developing the program to run on the PLC consists of: using an editor to draw the source ladder program, converting the source program to binary object code which will run on the PLC's microprocessor and downloading the object code from the PC to the PLC system via the serial communication port. The PLC system is online when it is in active control of the machine and monitors any data to check for correct operation.

5. WORKING STEP DESCRIPTION

Our prime goal of this project is to design a demo of the actual working process and to understand the automation process of practical field. At first, we shall design an industrial process and then comparing with an actual process, we have to design our own demo. We take three steps to accomplish the project.

Step 1 Let's assign everything we physically need to an input or output.

Input 1: 1^{st} floor wall button
Input 2: 2^{nd} floor wall button
Input 3: 3^{rd} floor wall button
Input 4: 1^{st} floor inside car button
Input 5: 2^{nd} floor inside car button
Input 6: 3^{rd} floor inside car button
Input 7: 1^{st} floor sensor
Input 8: 2^{nd} floor sensor
Input 9: 3^{rd} floor sensor
Output 1: Motor up
Output 2: Motor down

Step 2 Think about the logic of the program

Initially wait for a wall or car button to be pressed

1-Has a wall or car button been pressed yet?

a. No - keep waiting
b. Yes – Turn on up or down motor depending upon which button pressed

2-Has appropriate floor sensor turned on signaling car has arrived?

a. No – keep waiting
b. Yes – turn off up or down motor depending upon floor sensor

Step 3 Design the ladder program that will do the above steps.

6. DESCRIPTION OF THE CONTROL PANEL

The 8 inputs and 2 outputs used in this project are listed As shown in Fig. 4, the elevator system consists of three sections: internal requests, external requests, and the elevator position. The internal requests are represented by the push buttons inside the elevator which consists of six push buttons, three for wall and three for car. The external requests (wall button) are represented by the three push buttons located outside the elevator and distributed according to their corresponding floors. The internal requests (car button), it consists of three push buttons distributed according to the position of the level. The elevator position is displayed by the three LEDs, one for each level, which are directly controlled by the PLC according to the location of the elevator.

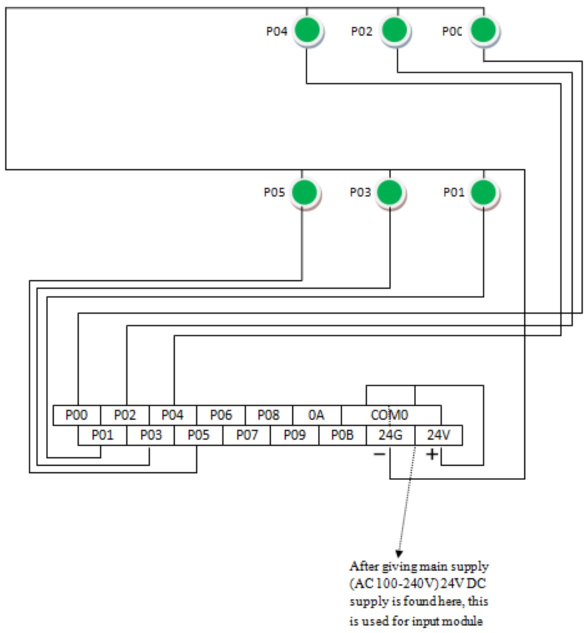

Figure-5: Connection of PLC with input panel.

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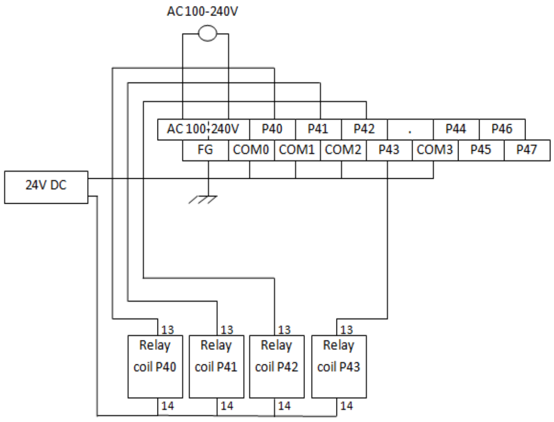

Figure-6: Connection of PLC with output panel.

Figure-7: Final project view

7. FUTURE SCOPE OF WORK

The elevator system designed and implemented in this project was restricted to three levels. This restriction was due only to the limited number of inputs and outputs provided by the PLC used. However, to extend the system to more than four levels, some suggestions are made below:

Suggestion 1
Use a more powerful PLC. PLCs come in different sizes and with various capabilities. When increasing the number of levels in the elevator system, the designer must identify the number of inputs and outputs required to select the most suitable PLC.

Suggestion 2
Use two LG PLCs working together. One PLC can be dedicated to the control of the lower three floors while the other controls the upper three floors.

Suggestion 3
The use of a more elaborate input/output interface board together with a single LG PLC is worthwhile investigating. It should however be borne in mind that, in this case, the overall system cost should be kept lower than that in the previous two suggestions.

8. CONCLUSION

In this paper, the successful design and implementation of the intelligent control of a 3-level elevator system using only a small educational PLC was discussed. The design includes a simple scheme that aims at a easy compromise circuit panel and speed of response without requiring any extra circuitry. Some suggestions as to how to extend the design to handle a larger number of floors were also given. Finally, it is hoped that this work has demonstrated that, despite their limited control capabilities, small educational PLCs when fully exploited, can indeed tackle industrial control jobs of modest size in a cost-effective way.

9. ACKOWLEDGEMENT

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