

MICROCONTROLLER BASED ROOM CONTROL SYSTEM

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Abstract

There are fluorescent lamp and electric fan in a room. To show the number of people in the room and to switch on and switch off fluorescent lamp and electric fan, the work of “Microcontroller Based Room Control System” is designed and carried out. There are two microswitches namely ENTER and EXIT. When a person enters the room, ENTER switch is pressed, the number of people is increased by one. When a person leaves the room, EXIT switch is pressed, the number of people is decreased by one. If there is no one in the room, both fluorescent lamp and electric fan are switched off. If there is at least one person, the fluorescent lamp is switched on. If there are five people and above, electric fan is also switched on. The required program is written in Pic BASIC Pro programming language. It is compiled and downloaded into PIC16F84A microcontroller with the aid of GTP USB Lite programmer.

Keyword: PIC16F84A microcontroller, fluorescent lamp, electric fan

Introduction

Rooms can be found in everywhere. Living rooms, meeting rooms and class rooms are familiar to us. In these rooms, fluorescent lamps and electric fans are installed. Switching on and switching off of these fluorescent lamps and electric fans are done manually by human beings.

The microcontroller is simply a computer on a chip. It is one of the most important developments in electronics. The microcontroller contains the same main elements as any computer systems: processor, memory and input / output.

Using the properties of microcontroller, switching on and switching off of fluorescent lamps and electric fans are controlled by PIC16F84A microcontroller and the condition is displayed by the LCD (LMB162A).

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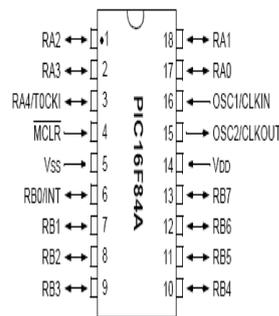
General Description of Some Devices Used in Constructed System

A microcontroller is a single chip computer. Micro suggests that the device is small, and controller suggests that the device can be used in control applications. Another term used for microcontrollers is embedded controller, since most of the microcontrollers are built into (embedded in) the devices they control.

The PIC16F84A belongs to the mid-range family of the PIC microcontroller devices. It has two I/O ports: PORTA and PORTB. PORTA has RA0 to RA4 and PORTB has RB0 to RB7. There are thirteen I/O pins with individual direction control. The program memory contains 1K words. The data memory (RAM) contains 68 bytes. Data EEPROM is 64 bytes. Its operating voltage range is 2.0V to 5.5V. The photograph of PIC16F84A is shown in Fig. (1-a). Fig. (1-b) shows the pin diagram of PIC16F84A.



(a)



(b)

Fig. (1)(a) Photograph of PIC16F84A (b) Pin diagram of PIC16F84A

The LM7805 of three terminal regulators is available with fixed output voltage making it useful in a wide range of applications. Although designed primarily as fixed voltage regulator, the device can be used with external component to obtain adjustable voltages and currents. The photograph of LM7805 is shown in Fig. (2).



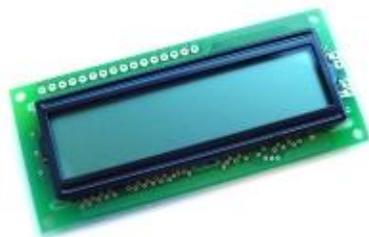
Fig. (2) Photograph of LM7805

A photocoupler device can be simply described as a sealed self-contained unit that houses independently powered optical Tx and Rx units that can be coupled together optically. Fig. (3) shows the photograph of photocoupler (PC817).

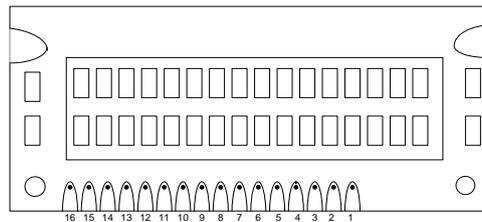


Fig. (3) Photograph of PC817

Alphanumeric dot matrix liquid crystal display (LMB162A) is used for displaying visual information, symbols, alphanumeric and icons in an impressive fashion. These modules have built-in controllers, drivers, character generator RAM \ ROM, and associated circuitry for easy implementation of the logic for refreshing, multiplexing and updating the display. In this work, LCD of LMB162A is used. The LMB162A module incorporates the control circuits, data RAM, and character generator RAM required for display. This module provides both 8 bit and 4 bit parallel interfaces and allows the controlling microprocessor to read and write data directly. General features of the LMB162A are 16 characters x 2 lines, 5 x 7 dots character structure, 80 characters data RAM, 192 characters generator, 8 characters generator RAM. The photograph of liquid crystal display is shown in Fig. (4-a). Fig. (4-b) shows the pin layout of the LCD module.



(a)



(b)

Fig. (4)(a) Photograph of liquid crystal display (b) Pin layout of the LCD Module

Hardware and Software Implementation

The construction of “Microcontroller Based Room Control System” is composed of seven units. They are

1. Regulated Power Supply Unit
2. Enter Switch Unit
3. Exit Switch Unit
4. Microcontroller Control Unit
5. Display Unit
6. Fluorescent Lamp Control Unit
7. Electric Fan Control Unit

The block diagram of the constructed system is shown in Fig. (5).

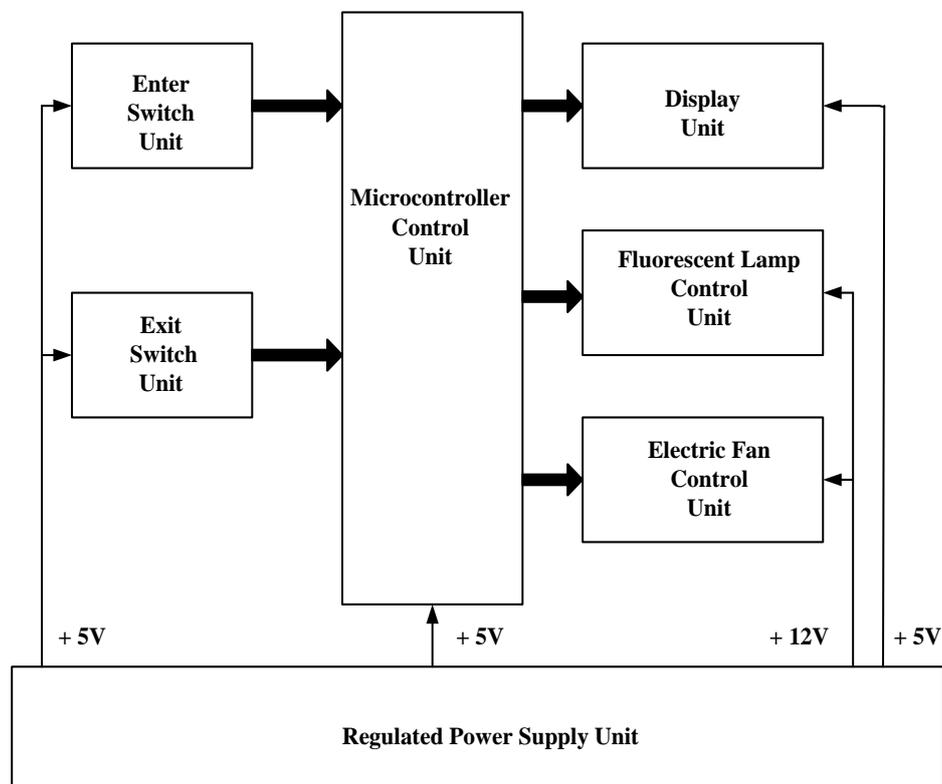


Fig. (5) The block diagram of the constructed system

Regulated power supply unit produces the required DC +5V and DC +12V for the system. The required DC voltages are converted from the AC 220V, 50Hz line voltage.

Enter switch unit is constructed by a 10K resistor and a microswitch. One end of the resistor is connected to DC +5V and the other end is connected to microswitch. One end of the microswitch is also connected to pin 17 (RA0) of microcontroller (PIC16F84A) and the other end is connected to ground level. When a person presses the ENTER switch, a logic 0 is fed to the PIC microcontroller.

Exit switch unit is constructed by a 10K resistor and a microswitch. One end of the resistor is connected to DC +5V and the other end is connected to microswitch. One end of the microswitch is also connected to pin 17 (RA0) of microcontroller (PIC16F84A) and the other end is connected to ground level. When a person presses the ENTER switch, a logic 0 is fed to the PIC microcontroller.

Microcontroller control unit controls the operation of the whole circuit. The written program is embedded into the PIC16F84A microcontroller. Pin 14 (VDD) is tied to DC +5V and pin 5 (VSS) is grounded. Pin 4 ($\overline{\text{MCLR}}$) is also connected to RESET switch. As long as the RESET switch is pressed, the system is in reset condition. A 4MHz crystal is fixed at pin 15 (OSC2) and pin 16 (OSC1). ENTER switch is fixed at pin 17 (RA0) and EXIT switch is fixed at pin 18 (RA1). Pin 6 (RB0), pin 7 (RB1), pin 8 (RB2), pin 9 (RB3), pin 10 (RB 4) and pin 11 (RB5) of PIC16F84A are connected to pin 11 (DB4), pin 12 (DB5), pin 13 (DB6), pin 14 (DB7), pin 6 (E) and pin 5 (RS) of LCD (LMB162A) respectively. Pin 1 (RA2) is connected to electric fan control unit and pin 2 (RA3) is connected to fluorescent lamp control unit.

Display unit shows the number of people in the room. In this unit, 16 characters x 2 lines LCD module is used. The liquid crystal display (LMB162A) has eight data lines, three control lines and three power lines. The brightness control is also fixed in the constructed circuit. Pin 2 (VDD) is connected to DC +5V and pin 1 (VSS) and pin 5 (R/W) are grounded. The pin 3 (VEE) is connected to middle pin of 5K variable resistor. One end of it is connected to DC +5V and the other end is connected to ground level. Pin 11 (DB4), pin 12 (DB5), pin 13 (DB6), pin 14 (DB7), pin 6 (E) and pin 4 (RS) are connected to pin 6 (RB0), pin 7 (RB1), pin 8 (RB2), pin 9 (RB3), pin 10 (RB4) and pin 11 (RB5) of PIC16F84A microcontroller respectively.

Fluorescent lamp control unit controls to switch on and switch off fluorescent lamp. Pin 1 (RA2) of PIC16F84A microcontroller is connected to pin 1 of photocoupler (PC817). Pin 2

and pin 4 of PC817 are grounded. Pin 3 of PC817 is connected to DC +12V relay coil. The relay is connected to fluorescent lamp which is supplied by AC 220V.

Electric fan control unit controls to switch on and switch off electric fan. Pin 2 (RA3) of PIC16F84A microcontroller is connected to pin 1 of photocoupler (PC817). Pin 2 and pin 4 of PC817 are grounded. Pin 3 of PC817 is connected to DC +12V relay coil. The relay is connected to electric fan which is supplied by AC 220V.

The constructed DC +5V regulated power supply circuit diagram is shown in Fig. (6).

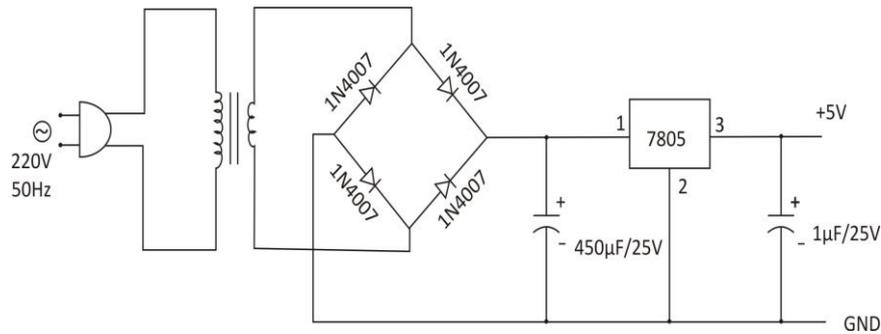


Fig. (6) DC +5V regulated power supply circuit

The constructed DC +12V regulated power supply circuit diagram is shown in Fig. (7).

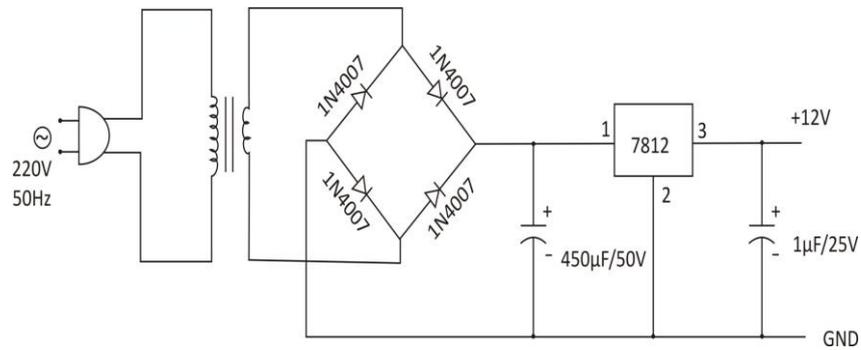


Fig. (7) DC + 12 V regulated power supply circuit

The complete circuit diagram of the constructed system is shown in Fig. (8).

PIC microcontroller works only when it is embedded with program. In program writing, the flowchart is drawn for the steps in sequence. The program source code is written referring to the flowchart. The source code is written in Pic Basic Pro language in Microcode Studio software. Fig. (9) shows the photograph of Microcode Studio software application.

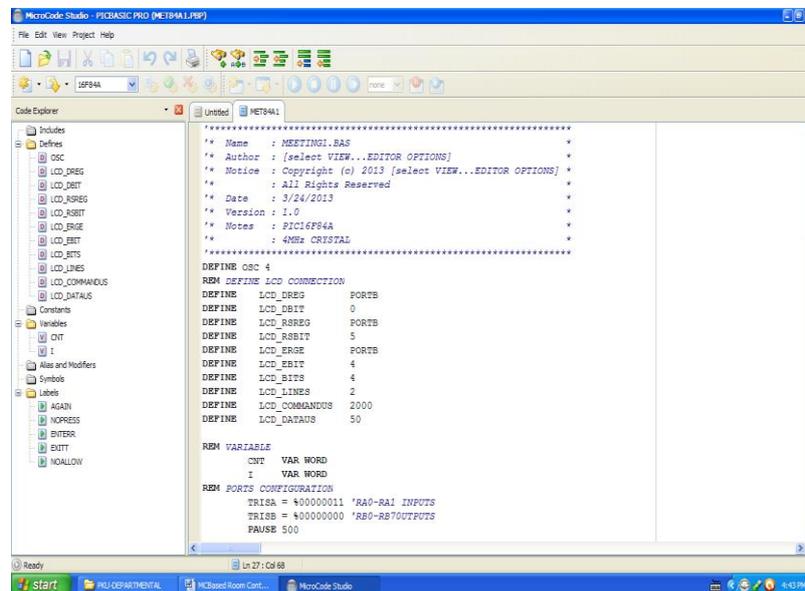
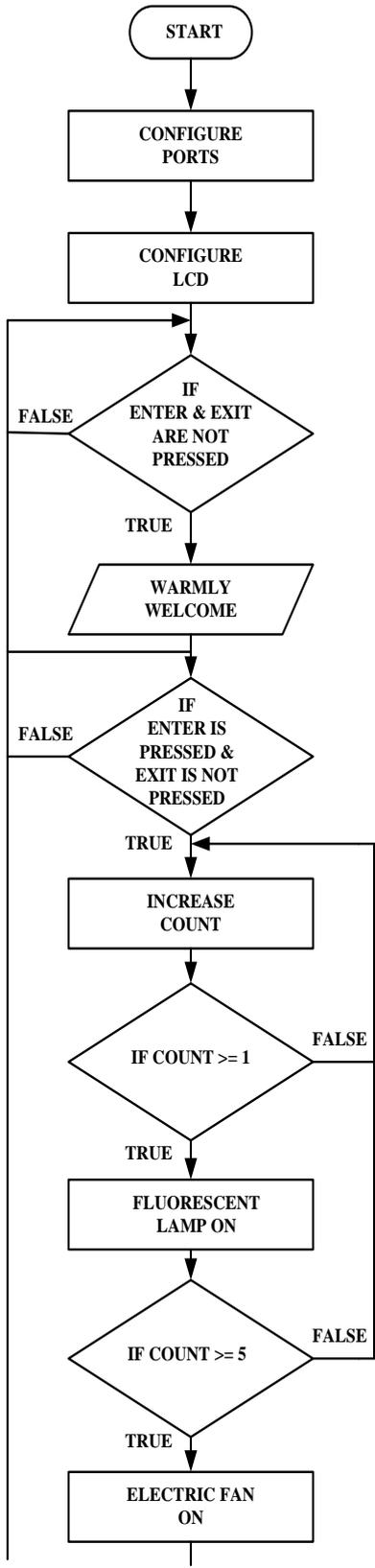


Fig. (9) Photograph of Microcode Studio software application

Fig. (10) shows the flowchart for microcontroller control system.



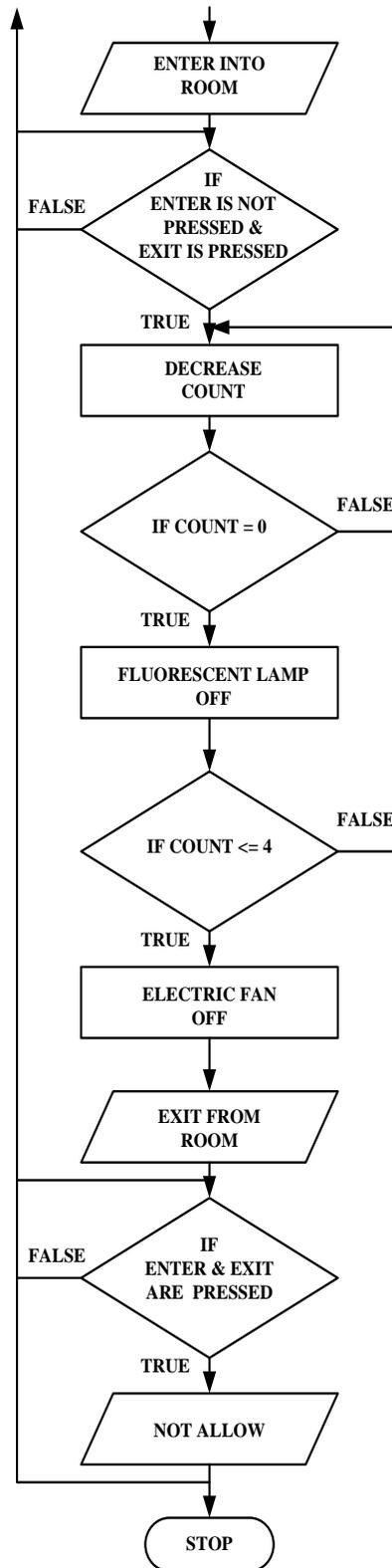


Fig. (10) Flowchart for microcontroller control system

Results and Discussion

The work of “Microcontroller Based Room Control System” shows the number of people in the room. Depending on the number, fluorescent lamp and electric fan are switched on and switched off automatically.

The circuit is designed and the whole operation is controlled by the PIC16F84A microcontroller in which the written program is embedded. The current condition is displayed by liquid crystal display (LMB162A).

The photograph of constructed circuit is shown in Fig. (11).

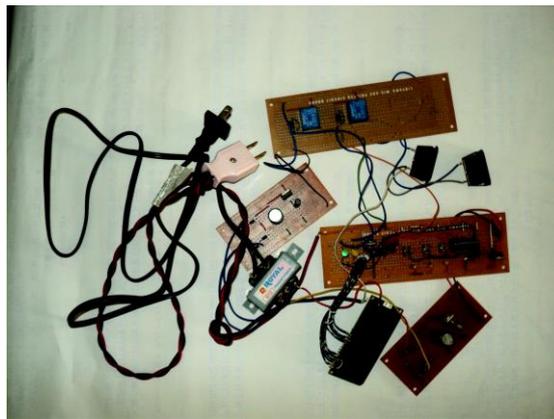


Fig. (11) Photograph of constructed circuit

The photograph of initial condition is shown in Fig. (12).



Fig. (12) Photograph of initial condition

The photograph of condition while ENTER switch is being pressed is shown in Fig. (13).



Fig. (13) Photograph of condition while ENTER switch is being pressed

The photograph of condition while EXIT switch is being pressed is shown in Fig. (14).

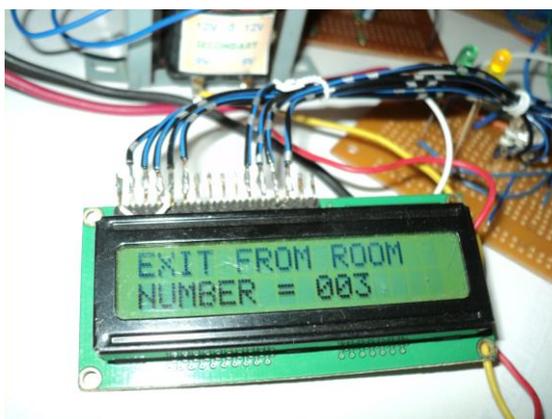


Fig. (14) Photograph of condition while EXIT switch is being pressed

The photograph of controlling fluorescent lamp is shown in Fig. (15).

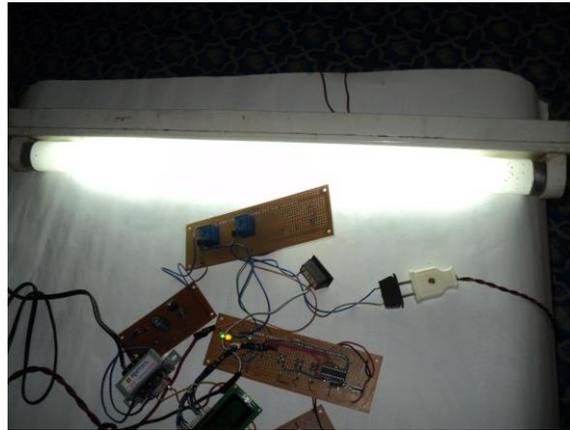


Fig. (15) Photograph of controlling fluorescent lamp

The photograph of controlling electric fan is shown in Fig. (16).

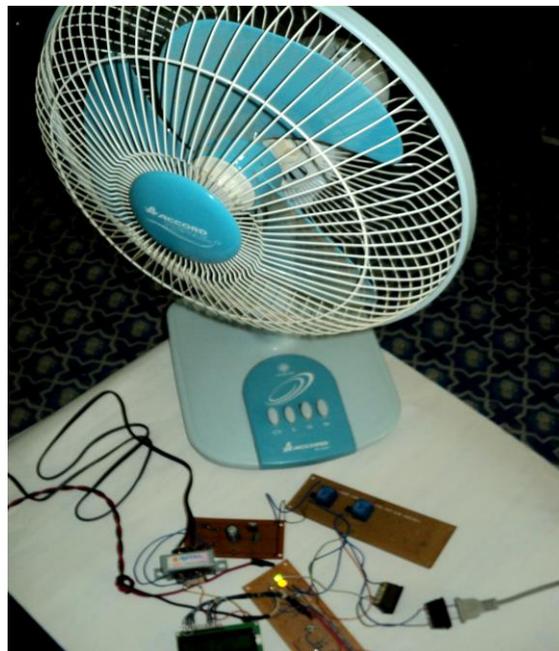


Fig. (16) Photograph of controlling electric fan

Conclusion

Most of the rooms are equipped with fluorescent lamps and electric fans. Therefore, it is an additional task of a person to switch on and switch off fluorescent lamps and electric fans manually.

The constructed system can reduce this additional task because the system is designed to switch on and switch off fluorescent lamp and electric fan automatically according to the number of people in the room.

In this work, the program is designed to switch on fluorescent lamp when at least one person is in the room. The electric fan will switch on when five people and above are in the room. If there is no one in the room, both fluorescent lamp and electric fan are switched off. The program can be redesigned if it is needed. So, the system is suitable to be used at many places.

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