Traffic Light Project Report

By

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The PIC16F877A is a 40-pin microcontroller with various pins for different functionalities.

1. **RA0 - RA5 (Pins 2-7):**
   - Function: Analog/Digital I/O
   - These are general-purpose I/O pins. They can be configured as analog inputs for the ADC module or as digital I/O pins.

2. RB0 - RB7 (Pins 33-40):

- Function: Digital I/O
- These pins are primarily used as digital I/O pins. RB0 can also be used for external interrupts as well as RB4 to RB7

3. RC0 - RC7 (Pins 15-18, 23-26)

- Function: Digital I/O
- General-purpose digital I/O pins. RC6 and RC7 are used for UART (TX and RX) communication.
- UART stands for Universal Asynchronous Receiver/Transmitter, used for asynchronous serial communication, meaning there is no shared clock signal between the transmitting and receiving devices.

4. RD0 - RD7 (Pins 19-22, 27-30)

- Function: Digital I/O
- These are general-purpose digital I/O pins.

5. RE0 - RE2 (Pins 8-10)

- Function: Analog/Digital I/O
- These pins can serve as analog inputs or digital I/O pins.

6. VSS (Pins 12, 31)

- Function: Ground
- These pins should be connected to the ground of the power supply.
- Some simulation softwares like proteus connect them automatically so they don’t give access to them

7. VDD (Pins 11, 32)

- Function: Power Supply
- These pins are connected to the positive supply voltage.
- Some simulation softwares like proteus connect them automatically so they don’t give access to them

8. OSC1/CLKIN, OSC2/CLKOUT (Pins 13, 14)

- Function: Oscillator/Clock (Input - Output)
- This pin is used for the external clock (input - output) or to connect an external crystal.

10. MCLR (Pin 1)

- Function: Master Clear (Reset) Input
- This pin is used to reset the microcontroller. It should be connected to a pull-up resistor.

Main Blocks of PIC16F877A

1. ALU (Arithmetic Logic Unit)

- Function: Performs arithmetic (addition, subtraction) and logical (AND, OR, NOT) operations.

2. Status and Control

- Function: Monitors and controls the operations of the microcontroller.
- This block includes special purpose registers like the STATUS register, which keeps track of the results of ALU operations, and control registers that configure how the microcontroller operates.

3. Program Counter (PC)

- Function: Keeps track of the address of the next instruction to be executed.
- The Program Counter increments with each instruction, so the microcontroller knows where to get the next command from the program memory.

4. Flash Program Memory

- Function: Stores the program code that the microcontroller executes.
- Non-volatile memory that gets the program code even when the power is turned off. It can store up to 8 KB of code.

5. Instruction Register

- Function: Temporarily holds the current instruction being executed.
- When an instruction is loaded from the program memory, it’s placed in the Instruction Register for decoding and execution.

6. Instruction Decoder

- Function: Interprets the loaded instruction and determines the actions needed to execute it.
- Converts the binary code of the instruction into control signals that tell the other parts of the microcontroller to perform specific operations.

Q: Why is a led which is connected to RA4 for flashing purposes not working probably.

Because RA4 is an open-drain output so it can only pull a connection to ground so when it is set to high it doesn't drive the voltage high. Instead, it leaves the line floating. To solve this problem an external pull-up resistor (typically **10kΩ**) is used which drives the voltage high if the pin is set to high instead of leaving it floating.

Comparison between ATMega328P and PIC16F877A

1. Memory Size
    a. **ATMega328P**
        i. Flash Memory: 32 KB
        ii. SRAM: 2 KB
        iii. EEPROM: 1 KB
    b. **PIC16F877A**
        i. Flash Memory: 8 KB
        ii. SRAM: 368 Bytes
        iii. EEPROM: 256 Bytes
2. Power Consumption
    a. **ATMega328P** consumes less power than **PIC16F877A**

3. Pin Count
    a. **ATMega328P (**28-32) pins
    b. **PIC16F877A** 40 pins

ATMega328P is a better choice when creating Battery-Powered devices because it consumes less power and Wearable technology like smart watches because it has less pins so less size and consumes less power.

Traffic Light Project

The project can be found on this github repository including the circuit and the code :
https://github.com/saQr301/Traffic_Light_Project.git

1. **Connections**
    a. At pin 1 a reset button is connected to reset the microcontroller
    b. The crystal with frequency of 8MHz is connected to pin 13 and 14
    c. From RD0 to RD3 is connected to four 7 segment display using transistors to open and close them to allow multiplexing of them
    d. From RC0 to RC6 is connected to the displays which hold the numbers that will be displayed on them
    e. RB0 is connected to a pull down button to interrupt the PIC and enter the manual mode
    f. A switch is connected to one pin to allow switching between WEST and SOUTH road in manual mode
    g. 6 pins are used to light up 2 traffic lights

2. **Code flow explained**

a. Initialize Ports
b. Runs Automatic mode if not interrupted
c. If interrupted
    i. Check if the button is released set the interrupt flag to zero and exit the interrupt function immediately and continue the automatic code
    ii. Else
        1. If the switch is on west (PORTB.B4 is high) then set a counter from 3 and open the yellow led in the south road then close it
            a. While the switch is on west and the interrupt button is pressed open the green light on west and the red light on south
        2. Else if switch is on south (PORTB.B4 is low) then set a counter from 3 and open the yellow led in the west road then close it
            a. While the switch is on south and the interrupt button is pressed open the green light on south and the red light on west