Embedded Report

Task 1

Pin Description:

1. RA0 - Analog input or digital I/O pin
2. RA1 - Analog input or digital I/O pin
3. RA2 - Analog input or digital I/O pin
4. RA3 - Analog input or digital I/O pin
5. RA4/T0CKI - Analog input or digital I/O pin, or Timer0 external clock input
6. RA5 - Analog input or digital I/O pin
7. RE0 - Digital I/O pin
8. RE1 - Digital I/O pin
9. RE2 - Digital I/O pin
10. VSS - Ground
11. VDD - Power supply
12. OSC1/CLKIN - Oscillator input pin
13. OSC2/CLKOUT - Oscillator output pin
14. RC0 - Digital I/O pin or CCP1/P1A PWM output
15. RC1 - Digital I/O pin or CCP2/P1B PWM output
16. RC2 - Digital I/O pin or CCP1/P1A PWM output
17. RC3 - Digital I/O pin or CCP2/P1B PWM output
18. RC4 - Digital I/O pin or SDA I2C bus
19. RC5 - Digital I/O pin or SCL I2C bus
20. RC6/TX/CK - Digital I/O pin, USART transmit or synchronous serial clock
21. RC7/RX/DT - Digital I/O pin, USART receive or synchronous serial data
22. RD0 - Digital I/O pin
23. RD1 - Digital I/O pin
24. RD2 - Digital I/O pin
25. RD3 - Digital I/O pin
26. RD4 - Digital I/O pin or P1D PWM output
27. RD5 - Digital I/O pin or P1C PWM output

28. RD6 - Digital I/O pin or P1B PWM output
29. RD7 - Digital I/O pin or P1A PWM output
30. VSS - Ground
31. VDD - Power supply
32. RB0 - Digital I/O pin or INT0 external interrupt input
33. RB1 - Digital I/O pin or INT1 external interrupt input
34. RB2 - Digital I/O pin or INT2 external interrupt input
35. RB3 - Digital I/O pin or CCP1/P1A PWM output
36. RB4 - Digital I/O pin or PGM pin for in-circuit serial programming
37. RB5 - Digital I/O pin or PGC pin for in-circuit serial programming
38. RB6 - Digital I/O pin or PGD pin for in-circuit serial programming
39. RB7 - Digital I/O pin or PGM switch for in-circuit serial programming
40. VSS – Ground

Main Blocks and Their Functions:

1. ALU (Arithmetic Logic Unit): The ALU is responsible for performing arithmetic and logical operations on data. It can perform operations such as addition, subtraction, AND, OR, XOR, and shift operations. The ALU operates on data stored in the registers or memory and produces the result of the operation that is stored in the destination register or memory location.
2. Status and Control: The Status and Control block contains status registers that hold the current status of the microcontroller, such as the Carry flag, Zero flag, and Overflow flag, among others. It also contains control registers that control the operation of the microcontroller, such as the Interrupt Enable and Interrupt Priority registers.
3. Program Counter: The Program Counter (PC) is a register that holds the address of the next instruction to be executed. The PC is incremented after each instruction is executed, and the microcontroller fetches the next instruction from the memory location pointed to by the PC.
4. Flash Program Memory: The Flash Program Memory is the non-volatile memory used to store the program code. It is organized into multiple blocks and can be programmed and erased in-system. The program memory can be read by the microcontroller during normal operation to fetch instructions.
5. Instruction Register: The Instruction Register (IR) is a register that holds the current instruction being executed. The IR is loaded with the current instruction from the program memory during the instruction fetch cycle.
6. Instruction Decoder: The Instruction Decoder is responsible for decoding the instruction in the IR and generating control signals that control the operation of the microcontroller. The decoder interprets the instruction opcode and

determines which ALU operation to perform, which register to use as the source or destination, and what control signals to generate for the other blocks in the microcontroller.

Examine the reasons why a led, which is connected to RA4 for flashing purposes, does not work properly.

As pin4 in Port A is open drain, that means when the value is equal to 0 the nMOS transistor is acts as short circuit and the output equal zero, and when the value is equal to 1, the nMOS acts as open circuit and the output will be unknown.

Comparison between ATMega328P and PIC16F877A:

1. Memory size: The ATMega328P has 32 KB of flash memory, 1 KB of EEPROM, and 2 KB of SRAM, while the PIC16F877A has 14 KB of flash memory, 256 bytes of EEPROM, and 368 bytes of RAM. This means that the ATMega328P has more program memory and data memory available for use.
2. Power consumption: The ATMega328P has a lower power consumption compared to the PIC16F877A. The ATMega328P can operate at a lower voltage (down to 1.8V) and has lower power consumption in both active and sleep modes.
3. Pin count: The ATMega328P has 28 pins, while the PIC16F877A has 40 pins. This means that the PIC16F877A has more I/O pins available for use.

Based on these characteristics, the ATMega328P may be a better choice than the PIC16F877A for certain embedded systems. Here are two examples:

1. Battery-powered systems: If power consumption is a critical factor, the ATMega328P may be a better choice. Since the ATMega328P has a lower power consumption, it may be more suitable for battery-powered systems where power efficiency is a priority.
2. Low-cost systems: If cost is a critical factor, the ATMega328P may be a better choice. The ATMega328P is generally less expensive than the PIC16F877A and can be a good choice for low-cost embedded systems.

Task 2

Hardware

The main components used were:

- PIC16F877A microcontroller
- 2x 7447 7-segment decoder
- 2x 2 7-segment displays
- 2x BC-108 Transistors
- Resistors of different values
- Capacitors of different values
- Various buttons and switches
- 8MHZ Crystal
- LEDs

Pin Config:

Pins 13 and 14 are connected to the Crystal, pin RB0 is used to trigger interrupts to switch between Manual and Automatic modes. Pin RB1 is used to switch between lights in manual mode. The rest of Port B is used to control 6 LEDs that represent traffic lights. Pins RD6 and RD7 control the displays while Port C controls the data they display.

Software

Functions:

main()

manualTraffic()

autoTraffic()

timer()

display()

interrupt()