

Project: Traffic light controller

Scenario

Embedded systems are found almost everywhere; look around you and you will find many of them in your room, for example: your digital watch, your mp3 player, your digital camera, your TV remote control, and even inside your PC; even if you decide to go to your kitchen, you will find them in your microwave oven, your refrigerator, your washing machine, your cooker, and many many others. Moreover, Embedded systems can be classified as real-time and non-real-time, tied with deadlines or not, respectively.

To be an embedded engineer and work in such a field. In company, you are assigned to prepare a prototype of smart city control system. It is your responsibility to define hardware, software specifications and present them to your colleagues. Your task is also to code the program for the system. In Task2, you must build a prototype and system without internet connection.

Task1

In the system specification phase, your team must choose a Micro-controller to program on. The project leader appoints you to **host a presentation** on PIC16f877A of Microchip [1]. Audience will be your team members.

- Describe** all the pins of PIC16f877A. After that, your colleagues would have enough information once they need to interface the PIC16f877A with other hardware.
- Explain** to your colleagues the functions of the main blocks in PIC16f877A : ALU, Status and Control, Program Counter, Flash Program Memory, Instruction Register, Instruction Decoder.

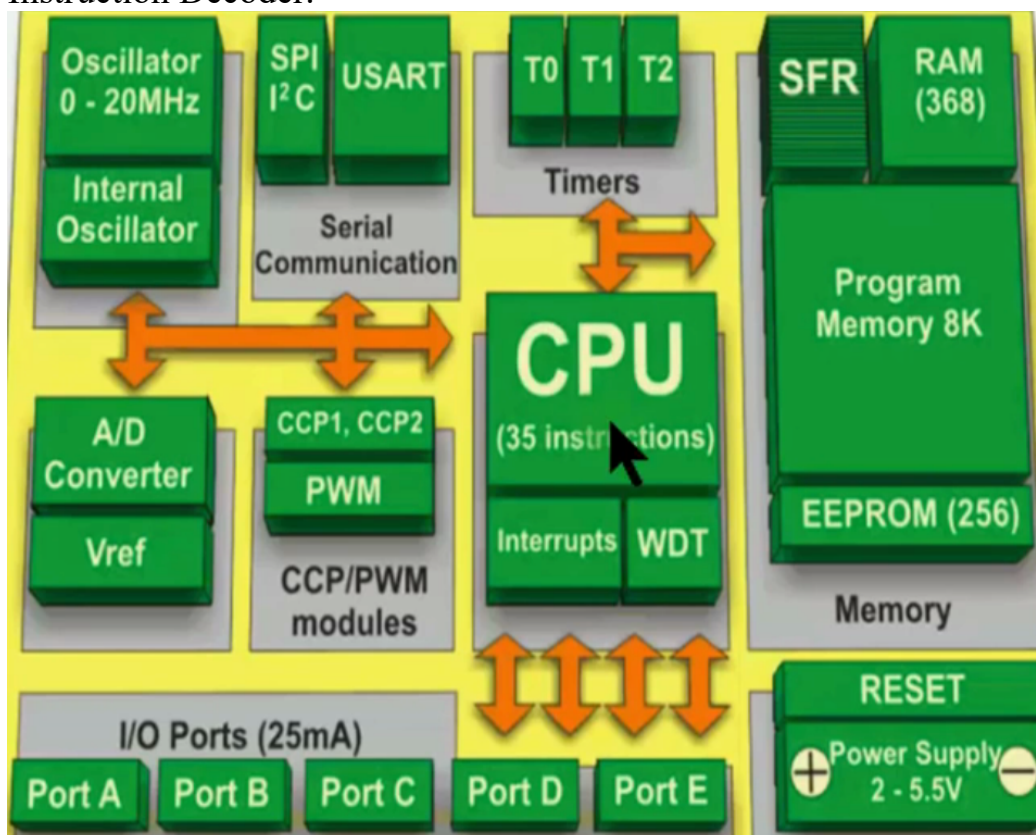


Figure 1: Block diagram of the AVR Architecture [1].

c) **Examine** the reasons why a led, which is connected to RA4 for flashing prepose not working probably.

d) ATmega328P [2] is also an 8-bit but AVR microcontroller. **Evaluate** the characteristics of ATmega328P versus PIC16f877A, by **comparing** the memory size, the power consumption, pin count... of those two MCUs. **Give 2 examples** of embedded systems where ATmega328P is a better choice than PIC16f877A.

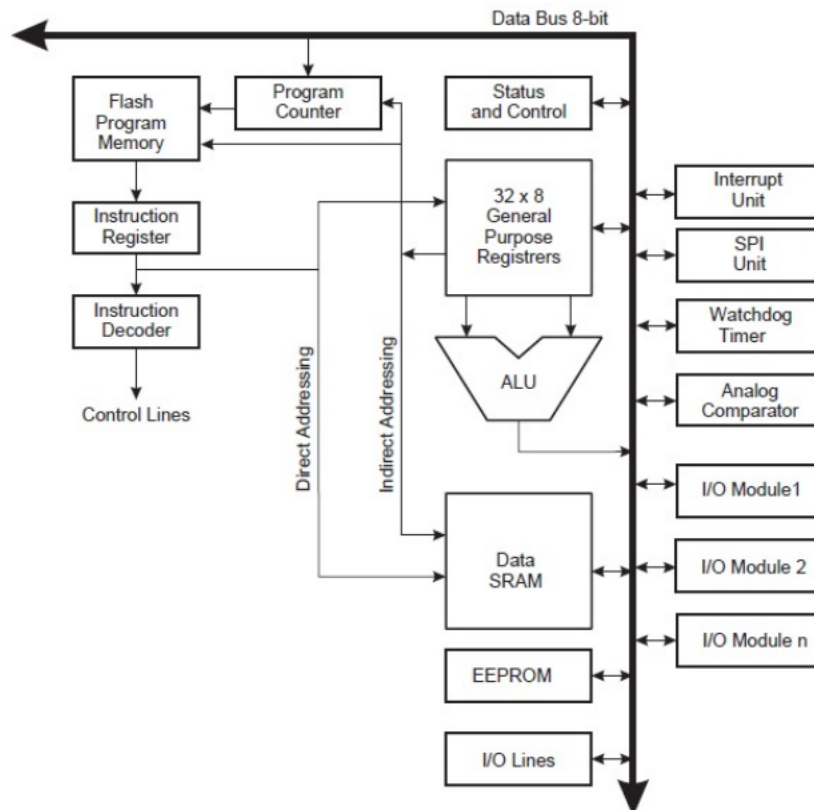
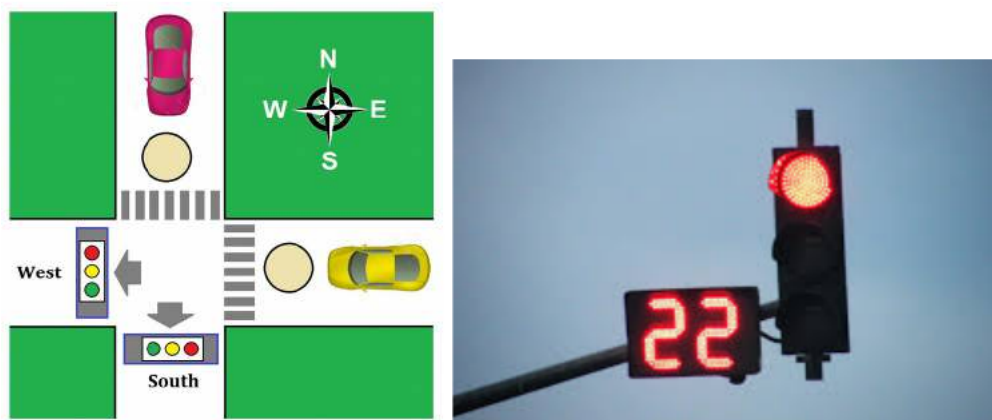


Figure 2: Block diagram of the PIC Architecture [2].

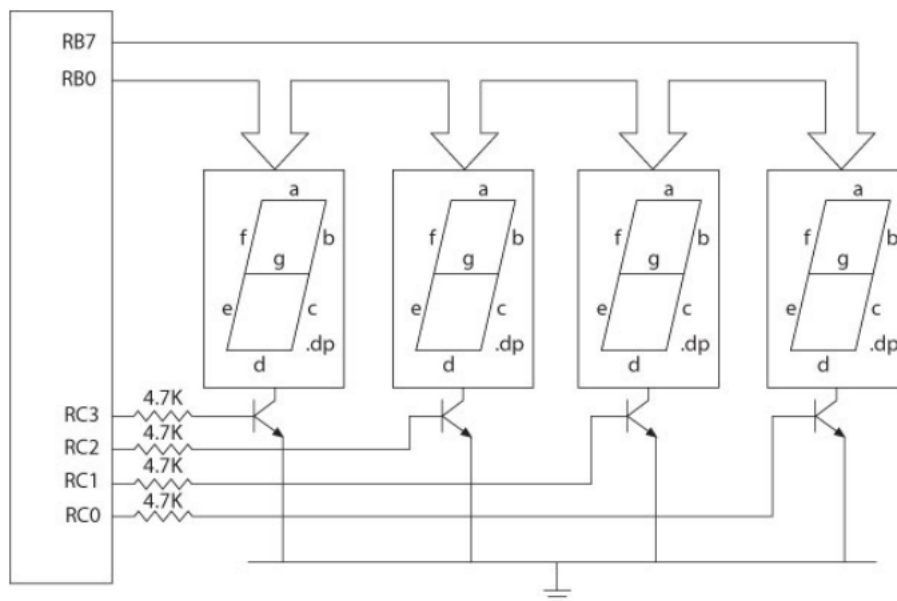
Task2

After exploring the features on PIC16f877A, you all will build a traffic light controller, to get familiar with PIC environment.



You will use 2 switches: one for Manual/Automatic and one for switching between 2 streets in Manual mode. The timing in Automatic mode: West street (15s Red, 3s Yellow, 20s

Green), South street (23s Red, 3s Yellow, 12s Green). Remember to apply the 3s of Yellow even in Manual mode. The 7-segments LEDs at each corner should be implemented using BJTs as in the following schematic to reduce the number of pins in used. The 7447 IC is also recommended to those who expected higher score.



- Draw** the circuit for the whole system using electronic circuits simulator program.
- Sketch** the flowchart for programming.
- Code** the PIC and demonstrate at the end of assignment deadline.
- Implement** the circuit for the whole system. [optional]
- Evaluate** the previous system correctness and speed. [optional]

References and sources of information

1. John Catsoulis, **Designing Embedded Hardware**, 2005.
2. Qing Li and Carolyn Yao, **Real-Time Concepts for Embedded Systems**, 2003.
3. Michael Barr, **Programming Embedded Systems in C and C++**, 1999.

Good Luck

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