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AI-generated content may be incorrect.

1.A.pin description of pic (16f877A)

| **Pin Numbers** | **Direction** | **Alternate Functions** | **Main Functions** | **Port** |
| --- | --- | --- | --- | --- |
| VDD (11, 32), VSS (12, 31), MCLR (1), OSC1 (13), OSC2 (14) | - | - | Power, Ground, Reset, Clock | **Power & Oscillator** |
| Pins 2–7 | Bidirectional (6-bit) | AN0–AN4 (ADC) | Digital I/O | **PORTA (RA0–RA5)** |
| Pins 33–40 | Bidirectional (8-bit) | RB0/INT (External interrupt), RB4–RB7 (Interrupt-on-change) | Digital I/O | **PORTB (RB0–RB7)** |
| Pins 15–18, 23–26 | Bidirectional (8-bit) | RC6/TX & RC7/RX (USART), RC3/SCL & RC4/SDA (I²C), RC3/SCK, RC4/SDI, RC5/SDO (SPI), CCP1/CCP2 (PWM/Compare) | Digital I/O | **PORTC (RC0–RC7)** |
| Pins 19–22, 27–30 | Bidirectional (8-bit) | General-purpose digital I/O, Parallel Slave Port (PSP) | Digital I/O | **PORTD (RD0–RD7)** |
| Pins 8–10 | Bidirectional (3-bit) | AN5–AN7 (ADC), PSP control lines | Digital I/O | **PORTE (RE0–RE2)** |

1.INTRODUCTION TO EMBEDD SYSTEM

An **embedded system** is a specialized computer that combines **hardware** and (**firmware/software)** to perform specific functions within a larger system, unlike a general-purpose computer used for multiple tasks.



1.b.Core Architectural Blocks of the (PIC16F877A)

| **Block** | **Role / Function** |
| --- | --- |
| **ALU (Arithmetic Logic Unit)** | • Executes arithmetic operations (ADD, SUB) • Executes logic operations (AND, OR, XOR) • Processes data in registers |
| **Status & Control** | • An 8-bit register to hold flags set by the ALU, such as Carry (C), Digit Carry (DC), and Zero (Z). These flags are very important for decision-making in code (e.g., conditional branching). |
| **Program Counter (PC)** | • Tracks current instruction address • Determines next instruction or jump (GOTO, CALL) |
| **Flash Program Memory** | • Stores the program permanently (Non-volatile) • Provides fast access for instruction execution |
| **Instruction Register** | • Holds the current instruction fetched from memory • Sends instruction to Instruction Decoder |
| **Instruction Decoder** | • Decodes the instruction • Directs MCU units (ALU, Registers, Peripherals) to execute it |

1.C.Troubleshooting:Led on ra4 not flashing

RA4 is not a standard output.

it can only sink current (LOW)🡪 (Open-Drain) and floats when HIGH, not providing +5V.

Solution:

1.(Phisically)Connect LED anode to VCC (+5V) resistor and cathode to RA4 🡪 (pull up Resistance)

2.(Coding)When On R4 (0)🡪ON || When On R4 (1)🡪OFF

* LED lights when RA4 is LOW (0)
* turns off when HIGH (1) ;

| **Characteristic** | **PIC16F877A** | **ATmega328P (AVR)** |
| --- | --- | --- |
| **Flash Program Memory** | 8K words (~14 KB), limited for small to medium projects. | 32 KB, much larger, suitable for complex code (e.g., Arduino IDE). |
| **SRAM** | 368 Bytes only, restricts variables and buffers. | 2 KB, allows larger programs and more temporary data storage. |
| **EEPROM** | 256 Bytes for non-volatile storage. | 1 KB, about 4× bigger for permanent storage (e.g., system settings). |
| **I/O Pins** | 33 pins (5 full ports: PORTA–E). | 23 pins (in DIP package), but widely extended on Arduino boards. |
| **Operating Voltage** | 2.0V – 5.5V, mostly operates at 5V. | 1.8V – 5.5V, more flexible for low-voltage battery systems. |
| **Power Consumption** | Moderate consumption, limited sleep modes. | Very low consumption with multiple sleep modes (Idle, Standby, Power-down). |
| **Clock Speed** | Up to 20 MHz with external crystal. | Up to 20 MHz, with an internal 8 MHz oscillator option. |
| **Peripherals** | Supports: ADC (10-bit, 8-ch), UART, SPI, I2C, Timers. | Supports: ADC (10-bit, 6-ch), UART, SPI, I2C, Timers, wider PWM support. |

Examples where ATmega328P is a better choice than PIC16F877A:

1. **Arduino Uno projects** 🡪 faster prototyping, easy programming (IoT, robotics, sensor interfacing).
2. **Low-power battery devices** – such as wireless sensor nodes, due to **lower energy consumption**.