ESP32 Microcontroller

Introduction

The **ESP32** is a powerful, low-cost microcontroller developed by **Espressif Systems**. It integrates Wi-Fi, Bluetooth, and a dual-core processor, making it ideal for IoT and embedded systems.

Key Features

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- **Processor:** Dual-core 32-bit **Xtensa LX6 CPU** (up to 240 MHz)
- **Memory:** 520 KB SRAM, 448 KB ROM, External Flash up to 16 MB
- **Connectivity:** Built-in **Wi-Fi (802.11 b/g/n)** and **Bluetooth 4.2 / BLE**
- **GPIO:** 34 programmable GPIO pins
- **ADC:** 18 channels, 12-bit resolution
- **DAC:** 2 × 8-bit DACs
- **PWM:** Available on all GPIO pins
- **Communication Interfaces:** UART, I2C, SPI, CAN, I2S
- Ultra-low-power co-processor for deep-sleep operation
- On-chip hall sensor and temperature sensor
- Support for secure boot and hardware encryption

ESP32 Architecture Overview

The ESP32 integrates a dual-core CPU, wireless transceivers, memory, peripherals, and power management units in one SoC.

Main Components:

- **CPU:** Dual-core Xtensa LX6
- **Memory:** ROM (boot), SRAM (data), Flash (firmware)
- **Connectivity:** Wi-Fi, Bluetooth
- **Peripherals:** GPIO, ADC/DAC, timers, UART, SPI, I2C, CAN, I2S, PWM
- **ULP Co-processor:** Enables deep sleep with minimal energy use

ESP32-WROOM Development Board Components

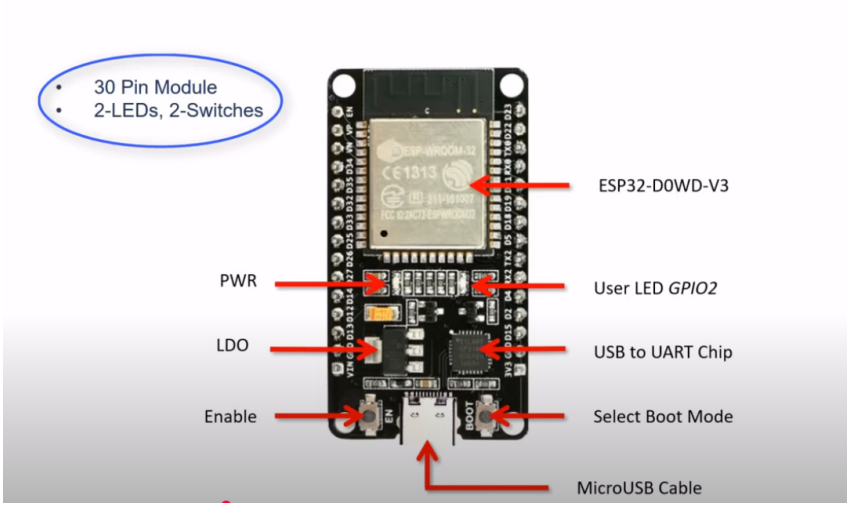

Figure 1: **ESP32-WROOM Development Board (Annotated Layout)**

Board Components

- **PWR (Power LED):** Lights up when the board receives power
- **User LED (GPIO2):** Onboard programmable LED for testing/debugging
- **LDO (Low Dropout Regulator):** Converts 5V USB input into stable 3.3V supply
- **Enable (EN Button):** Resets and restarts the ESP32 chip
- **BOOT (IO0 Button):** Used to enter firmware flashing/programming mode
- **MicroUSB Connector:** Provides 5V input power and USB communication with a PC
- **USB to UART Chip:** Converts USB signals to UART for flashing and debugging
- **ESP32-D0WD-V3 Chip:** Main SoC with CPU, Wi-Fi, Bluetooth, memory, and peripherals
- **General Purpose I/O:** 30 pins configurable as digital I/O, ADC, DAC, PWM, and communication interfaces
- **LEDs and Switches:** 2 LEDs (Power LED and User LED) and 2 switches (EN and BOOT)