**Types of Arduino Boards**

**1. Arduino Uno**

**Definition**

Arduino Uno is the most widely used and beginner-friendly microcontroller board from the Arduino family. It is based on the 8-bit ATmega328P microcontroller and is designed for easy and flexible embedded system development.

**What it is used for**

Arduino Uno is commonly used in educational projects, prototype development, home automation, simple robotics, and sensor interfacing. Its ease of programming and wide support make it ideal for beginners learning microcontrollers and electronics.

**What it contains**

* **ATmega328P microcontroller**: The main processing unit executing your program.
* **14 digital input/output pins**: Can be used to interface digital devices like LEDs, switches, motors, and sensors. Six pins support PWM (Pulse Width Modulation) to simulate analog output.
* **6 analog input pins**: Used to read analog sensors like temperature or light sensors.
* **USB Type-B connector**: For programming and serial communication with a computer.
* **16 MHz quartz crystal oscillator**: Provides a stable clock for the microcontroller.
* **Power jack and voltage regulator**: Allows the board to be powered externally via DC power supply (7-12V).
* **Reset button**: To restart the microcontroller program manually.

**Features**

* **Easy-to-use** programming interface with Arduino IDE.
* **Open-source hardware** design with a large community for support.
* **Supports serial communication** via USB, enabling easy debugging.
* **Compatible with various shields** (expansion boards) and modules.
* **Runs at 5V logic**, compatible with most sensors and actuators designed for this voltage.

**2. Arduino Leonardo**

**Definition**

Arduino Leonardo is a microcontroller board based on the ATmega32u4 chip, which integrates USB communication directly on the microcontroller, enabling native USB functionality.

**What it is used for**

It is mainly used when projects require the board to behave as a USB device such as keyboards, mice, or game controllers (HID devices). It’s also used for more advanced sensor interfacing with a higher number of input/output pins.

**What it contains**

* **ATmega32u4 microcontroller**: With built-in USB controller for direct USB communication.
* **20 digital input/output pins**: More pins than Uno, with 7 supporting PWM output.
* **12 analog inputs**: Additional inputs for sensors compared to Uno.
* **Micro USB port**: Smaller USB connector used for programming and USB device communication.
* **16 MHz crystal oscillator**: For clock stability.
* **Power jack**: For external power supply (7-12V).

**Features**

* **Native USB support** allows it to emulate USB peripherals like keyboard or mouse without extra hardware.
* **More I/O pins** than the Uno, supporting more complex projects.
* **Runs at 5V logic**, ensuring compatibility with many components.
* Can handle **complex USB communication protocols** for interactive devices.

**3. Arduino Mega 2560**

**Definition**

Arduino Mega 2560 is a powerful microcontroller board based on the ATmega2560 chip, designed for applications that require a large number of input/output pins and higher memory capacity.

**What it is used for**

Used in complex projects such as 3D printers, CNC machines, robotics requiring multiple motors and sensors, and automation systems needing simultaneous control of many devices.

**What it contains**

* **ATmega2560 microcontroller**: 8-bit MCU with large memory and many I/O ports.
* **54 digital I/O pins**: Provides extensive connections for switches, LEDs, motors, sensors, with 15 pins supporting PWM.
* **16 analog inputs**: Can read many analog sensors simultaneously.
* **USB Type-B port**: For programming and serial communication.
* **16 MHz crystal oscillator**: Provides clock for MCU operations.
* **Power jack and voltage regulator**: Supports external power supply.

**Features**

* **Huge number of I/O pins** supports large projects with many peripherals.
* **Large program memory (256 KB flash)** to store complex code.
* **More SRAM (8 KB)** allows better data handling and variable storage.
* Compatible with most Arduino shields and software libraries.
* **Runs at 5V logic level** suitable for many sensors and actuators.

**4. Arduino RedBoard**

**Definition**

The Arduino RedBoard is a board made by SparkFun that is fully compatible with Arduino Uno, but with better hardware components and USB communication chip for improved reliability.

**What it is used for**

Used similarly to Arduino Uno for beginners, educators, and makers, especially when a more robust and durable board is desired.

**What it contains**

* **ATmega328P microcontroller**: Same as Uno, handles program execution.
* **14 digital I/O pins**: Including 6 PWM pins.
* **6 analog input pins**: For sensor interfacing.
* **USB Mini-B port**: Smaller USB connector than Uno’s USB-B.
* **16 MHz crystal oscillator**: For clocking the MCU.
* **Power jack and voltage regulator**: For external power.

**Features**

* **Improved USB-to-serial converter (FTDI or CH340 chip)** for reliable programming and communication.
* **Robust hardware design** to withstand frequent use and connection cycles.
* Fully compatible with Arduino IDE and Uno shields.
* **Runs at 5V logic** standard for Arduino boards.

**5. Arduino Micro**

**Definition**

Arduino Micro is a compact, small-size board based on the ATmega32u4 microcontroller with native USB communication.

**What it is used for**

Used in projects where size is critical such as wearable technology, portable USB devices, custom keyboards, and small robotics.

**What it contains**

* **ATmega32u4 microcontroller**: With integrated USB controller.
* **20 digital I/O pins**: 7 pins capable of PWM output.
* **12 analog inputs**: For multiple sensor inputs.
* **USB Micro-B connector**: For programming and USB communication.
* **16 MHz crystal oscillator**: Provides clock signal.
* Does not have a separate power jack; powered through USB.

**Features**

* **Very small footprint (48mm x 18mm)**, ideal for compact designs.
* **Native USB HID support**, useful for USB device emulation.
* Compatible with Arduino IDE and most libraries.
* **Runs at 5V logic level**.
* Useful in **wearable electronics** and **USB interface devices**.

**6. Arduino Due**

**Definition**

Arduino Due is a high-performance board based on a 32-bit ARM Cortex-M3 microcontroller, offering more speed, memory, and advanced features than traditional Arduino boards.

**What it is used for**

Ideal for applications that need high processing power and memory such as audio processing, real-time control, complex robotics, and digital signal processing.

**What it contains**

* **Atmel SAM3X8E ARM Cortex-M3 microcontroller**: 32-bit CPU with 84 MHz speed.
* **54 digital I/O pins**: Including 12 PWM pins.
* **12 analog inputs** and **2 DAC outputs**: For analog sensors and output signals.
* **Two USB Micro-B ports**: One for programming, one for native USB communication.
* **Power jack and voltage regulator**: For external power supply.
* **Operates at 3.3V logic** (different from 5V boards).

**Features**

* **High clock speed (84 MHz)** for faster execution of complex tasks.
* **Large flash memory (512 KB) and SRAM (96 KB)** for big programs and data.
* **Dual USB ports** enable advanced USB device and host capabilities.
* **Multiple analog inputs and DAC outputs** enable precise analog control.
* **Runs at 3.3V logic level** — incompatible with some 5V sensors/shields without level shifting.

**Summary Table for Quick Reference**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Board** | **Microcontroller** | **Digital I/O Pins** | **Analog Inputs** | **USB Type** | **Voltage** | **Special Feature** |
| **Uno** | ATmega328P | 14 (6 PWM) | 6 | USB Type-B | 5V | Most popular, beginner-friendly |
| **Leonardo** | ATmega32u4 | 20 (7 PWM) | 12 | USB Micro-B | 5V | Native USB HID support |
| **Mega 2560** | ATmega2560 | 54 (15 PWM) | 16 | USB Type-B | 5V | Large I/O and memory |
| **RedBoard** | ATmega328P | 14 (6 PWM) | 6 | USB Mini-B | 5V | Robust USB interface |
| **Micro** | ATmega32u4 | 20 (7 PWM) | 12 | USB Micro-B | 5V | Small size, native USB |
| **Due** | SAM3X8E ARM Cortex-M3 | 54 (12 PWM) | 12 + 2 DAC | USB Micro-B (2x) | 3.3V | 32-bit ARM, high speed & memory |