Arduino

Introduction

Being able to create physical interfaces for web pages opens up new areas for innovation and creativity. It allows you to think of your project in two different mediums. You can create interactive displays and games, set up IOT components, then collect and process your own data; you can express your ideas in new ways.

An Arduino is a great way to create physical interfaces. It was designed to be an easy-to-use electronics platform that allows you to attach electronic components that can send and receive data. The respected Arduino community can be very helpful and creative if you need assistance.

The electronic components can be inputs or outputs. I have seen Arduinos used to create music, light shows, ovens, robots, art, and so much more. There is such a wide range of components including buttons, motors, potentiometers, sensors, and buzzers that can be attached to an Arduino.

Arduinos can send and receive data from a web server. This means you can control elements on a web page with physical components and use physical components to display information from your web page or online data.

Arduino

Arduino allows you to create your own electronics projects. It is a collection of open source hardware and software that allows you to attach and control other components to create an electrical circuit. Projects such as an automated plant watering system, a pizza oven, or a remote controlled toy car can be made with an Arduino. When you use an Arduino for a project you need to do the following:

- Connect components to it.
- Write a program to control the components.
- Verify that the program is written correctly.
- Upload the program to the Arduino.

The Arduino needs to be connected to a computer via a USB port to upload a program to it. Programs for Arduinos are called sketches. Once the sketch is uploaded, it is stored on the microcontroller and will stay there until another sketch is uploaded. Once a new sketch is uploaded the old sketch is no longer available.Once the sketch is uploaded you can disconnect the

Arduino from the computer, and if it is connected to another power source the program will still run.

Arduino Hardware

An Arduino board is made up of a number of components, including a microcontroller, digital and analog pins, power pins, resistors, a diode, a capacitor, and an LED.

A Microcontroller has a central processing unit (CPU); it stores the uploaded sketch and processes and directs the commands.The digital and analog pins are used for sending and receiving digital and analog data.The Arduino also has a serial interface that allows the Arduino to send data to a computer via the serial port; this is the way we will be sending data to and from a computer

Electricity

With an Arduino you create an electronic circuit that powers the components attached to it. Wires made of a conductive material connect the components that let electricity flow through them

Electricity is the movement of electrons through a conductive material. In conductive materials, electrons can move easily between atoms, but in non-conductive materials they can't.

Atoms are made up of protons, neutrons, and electrons. In the center of the atom are the nucleus, protons and neutrons; electrons are on the outside. Protons have a positive charge and electrons have a negative charge. These two charges are attracted to each other. The electrons are in orbit around the nucleus. In non-conductive materials such as wood or porcelain, it is difficult for the electrons to move; they are tightly bound to the atom. In conductive materials such as copper and other metals, there are electrons that are quite loosely bound to the atoms, so they can move easily. These electrons are on the outer edge of the atom and are called valence electrons.

Electrons move around the circuit from negative to positive. When electricity was first discovered, it was thought that they moved from positive to negative, so by convention the electronic circuits are often drawn from positive to negative, positive to ground (GND). In the circuits in this book the electricity will be flowing in one direction; this is called a direct current (DC), and in an alternating current (AC) the direction changes a certain number of times a second.To get the electrons in a conductive material to start moving they need a push, and this push is the voltage. Voltage is the difference between higher potential energy and lower potential energy in a circuit. The electrons want to flow from higher potential energy to lower potential energy, from the positive to the ground.

There are a number of ways that voltage is produced. In a battery, it is produced by a chemical reaction. A build-up of electrons is created at the negative end of the battery. When a connection is made to the positive end of the battery, the negative electrons are attracted to the positive, from the higher potential energy to the lower potential energy. This causes them to push the electrons on the wire; the electrons are shunted along the wire.

In Electricity current is the amount of electrons per second that passes a certain point. The current is measured in amps. Each component on the circuit uses up part of the electricity and turns it into another form of energy such as light or sound. The components on the circuit use all the energy in the circuit.

Resistors

Resistors are a crucial component for circuits as they limit the amount of current on the circuit. A resistor has a certain amount of resistance to the current flow. Every component has a maximum amount of current, measured in amps that it can safely use. For example, if a component can take a maximum of 0.023 amps, which is 23 milliamps, and your circuit is receiving 5V (volts), then a 220-ohm resistor will need to be added to the circuit to use the LED safely. The electrical components will use some of the power from the circuit; this is called a voltage drop so this can be taken into account when working out resistance.

The Breadboard

The breadboard is used in electronics for prototyping; it is a way to attach components to an Arduino without soldering. It is made of plastic and has a series of holes in it for the pins of the components and for wires. They commonly have two strips of holes down either side for power and ground. Inside the breadboard are strips of metal that are conductive. The wires and pins connect with these strips of metal to make a circuit. They can come in different sizes.

Digital and Analog

On an Arduino can use digital input, digital output, analog input, and analog output. A digital input or output can have one of two states, on or off (high or low). The analog input or output can be between 0 and 1023 when 5V is being used.

Analog Output

Analog output and input produce a range of numbers that go up and down in sequence. On an Arduino some of the digital pins have a "~" symbol next to them. These pins are used for analog output and use PWM (pulse width modulation).

Pulse Width Modulation

PWM is used to simulate an analog output with digital pins. A digital signal can be on or off, and it sends a pulse for on. PWM simulates an analog system using the digital signal by changing the length of the pulse; it's "on" time to simulate pulses between 5V and 0V.

Digital Input

A good circuit to show a digital input is a switch button. The switch button is either up or down, and it is in one of two states, pressed or not pressed. It brings in another concept called Input Pullup.

There is a problem for an Arduino with a switch. When a switch is open, it does not complete a circuit, and there is no voltage so the Arduino doesn't know what the input is; it could be 0 or it could be 1. As it doesn't know you can get strange results, it creates noise as the input value is unknown and it tries to put something in. This problem is solved with pullup resistors; it sets a voltage when the switch is open.

Analog Input

Analog input is used with components such as photoresitors and potentiometers, components that give varying values. An Arduino Uno can register values between 0 and 5 volts; with this you can get an analog input value between 0 and 1023. An analog input sends a signal voltage. When the signal voltage is received it is checked against an internal reference.

Arduino Models

Leonardo

The Leonardo board represents a bold leap forward for the Arduino platform. Although it supports the standard header layout, ensuring the continued use of shields, it also includes a USB controller that allows the board to appear as a USB device to the host computer. The board uses a newer ATmega32u4 processor with 20 digital I/O pins, of which 12 can be used as analog pins and 7 can be used as a pulse-width modulation (PWM) output. It has 32KB of flash memory and 2.5KB of SRAM.

The Leonardo has more digital pins than its predecessor but continues to support most shields. The USB connection uses a smaller USB connector. The board is also available with and without headers.

Uno

The Uno board is the first standard Arduino board featuring an ATmega328 processor; 14 digital I/O pins, of which 6 can be used as PWM output; and 6 analog input pins. The Uno board has 32KB of flash memory and 2KB of SRAM.

The Uno is available either as a surface-mount device (SMD) or a standard IC socket. The IC socket version allows you to exchange processors, should you desire to use an external IC programmer to build custom solutions . It has a standard USB type B connector and supports all shields.

Due

The Arduino Due is a new, larger, and faster board based on the Atmel SAM3X8E ARM Cortex-M3 processor. The processor is a 32-bit processor, and the board supports a massive 54 digital I/O ports, of which 14 can be used for PWM output; 12 analog inputs; and 4 UART chips (serial ports); as well as 2 digital-to-analog (DAC) and 2 two-wire interface (TWI) pins. The new processor offers several advantages:

- 32-bit registers
- DMA controller (allows CPU-independent memory tasks)
- 512KB flash memory
- 96KB SRAM
- 84MHz clock

The Due has the larger form factor (called the mega footprint)[1] but still supports the use of standard shields as well as mega format shields. The new board has one distinct limitation: unlike other boards that can accept up to 5V on the I/O pins, the Due is limited to 3.3V on the I/O pins.The Arduino Due is intended to be used for projects that require more processing power, more memory, and more I/O pins. Despite the significant capabilities of the new board it remains open source and comparable in price to its predecessors. Look to the Due for your projects that require the maximum hardware performance.

Mega 2560

The Arduino Mega 2560 is an older form of the Due. It is based on the ATmega2560 processor (hence the name). Like the Due, the board supports a massive 54 digital I/O ports, of which 14 can be used as PWM output; 16 analog inputs; and 4 UARTs (hardware serial ports). It uses a 16MHz clock and has 256KB of flash memory. The Mega 2560 is essentially a larger form of the standard Arduino (Uno, Duemilanove, etc.) and supports the standard shields the Arduino Mega 256 is the board of choice for Prusa Mendel and similar 3D printers that require the use of a controller board named RepRap Arduino Mega Pololu Shield (RAMPS).

Mini

The Arduino Mini is a small form-factor board designed for use with breadboards. Thus, it has all its pins arranged in male headers that plug directly into a standard breadboard. It is based on the ATmega328 processor (older models use the ATmega168) and has 14 digital I/O pins, of which 6 can be used as PWM output, and 8 analog inputs. The Mini has 32KB of flash memory and uses a 16MHz clock.

Unlike other Arduino boards, the Mini does not have a USB connector. To connect to and program the Mini, you must use a USB Serial adapter or RS232-to-TTL serial adapter.

Micro

The Arduino Micro is a special form of the new Leonardo board and uses the same ATmega32u4 processor with 20 digital I/O pins, of which 12 can be used as analog pins and 7 can be used as PWM output. It has 32KB of flash memory and 2.5KB of SRAM.

The Micro was made for use on breadboards in the same way as the Mini but in a newer, updated form. But unlike the Mini, the Micro is a full-featured board complete with USB connector. And like the Leonardo, it has built-in USB communication, allowing the board to connect to a computer as a mouse or keyboard

Nano

The Arduino Nano is an older form of the Arduino Micro. In this case, it is has the ATmega328 processor (older models use the ATmega168) and 14 digital I/O pins, of which 6 can be used as PWM output, and 8 analog inputs. The mini has 32KB of flash memory and uses a 16MHz clock.

Like the Micro, it has all the features needed for connecting to and programming via a USB connection.

Advantages

1. Ready to use

As Arduino comes in a complete package form which includes the 5V regulator, a burner, an oscillator, a micro-controller, serial communication interface, LED and headers for the connections. You don't have to think about programmer connections for programming or any other interface. Just plug it into USB port of your computer and that's it. Your revolutionary idea is going to change the world after just few words of coding.

2. Example of Code

Another big advantage of Arduino is its library of examples present inside the software of Arduino. I'll explain this advantage using an example of voltage measurement. For example if you want to measure voltage using ATmega8 micro-controller and want to display the output on computer screen then you have to go through the whole process. The process will start from learning the ADC's of micro-controller for measurement, went through the learning of serial communication for display and will end at USB – Serial converters. If you want to check this whole process click on the link below.

3.Effortless function

During coding of Arduino, you will notice some functions which make the life so easy. Another advantage of Arduino is its automatic unit conversion capability. You can say that during debugging you don't have to worry about the units conversions. Just use your all force on the main parts of your projects. You don't have to worry about side problems.

4.Large Community

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DisAdvantages

1.Structure

During building a project you have to make its size as small as possible. But with the big structures ofArduino we have to stick with big sized PCB's. If you are working on a small micro-controller like ATmega8 you can easily make your PCB as small as possible.

2.Cost

The most important factor which you cannot deny is cost. This is the problem which every hobbyist, Engineer or Professional has to face. Now, we must consider that the Arduino is cost effective or not

3.Esay to Use

In my opinion, if you started your journey of micro-controllers with Arduino then it will be very difficult for you to make the complex intelligent circuitries in future. The easy to use hardware/software of Arduino unable a person to learn the basics of many things likes Serial communication, ADC, I2C etc.