#### KEY WORDS:

# *1.ARDUINO:*

## *Learn about Arduino and the Arduino UNO and how you can integrate this board into your makerspace and coding program. Make interactive makerspace projects while learning to code and problem solve. More and more makerspaces around the world are looking to add coding and electronics to their maker education programs. One of the best ways to do this is by integrating an Arduino board into makerspace projects and lessons.*

## *We’ve found that a lot of maker educators haven’t taken the plunge into coding or Arduino because they think programming is scary. Because of this, we wanted to make sure this tutorial was written for the absolute beginner with no experience whatsoever. This tutorial is a high level view of all the parts and pieces of the Arduino ecosystem. In future posts, we will take you step by step in creating your first simple Arduino project*

## *. What Is Arduino? Arduino is an open source programmable circuit board that can be integrated into a wide variety of makerspace projects both simple and complex. This board contains a microcontroller which is able to be programmed to sense and control objects in the physical world. By responding to sensors and inputs, the Arduino is able to interact with a large array of outputs such as LEDs, motors and displays. Because of it’s flexibility and low cost, Arduino has become a very popular choice for makers and makerspaces looking to create interactive hardware projects.*

## *Arduino was introduced back in 2005 in Italy by Massimo Banzi as a way for nonengineers to have access to a low cost, simple tool for creating hardware projects. Since the board is open-source, it is released under a Creative Commons license which allows anyone to produce their own board. If you search the web, you will find there are hundreds of Arduino compatible clones and variations available but the only official boards have Arduino in it’s name. In the next section, we’re going to discuss a few of the Arduino boards available and how they differ from each other.*

# *ANALOG AND DIGITAL: PINS*

## *Digital Pins*

# *To read digital input, Arduino uses a function called******digitalRead(),******and it tells you if a voltage on a pin is HIGH (5volts) or LOW (0) volts. Before you can read the digital pin, you will need to tell the Arduino that the pin will be used for reading input. Therefore, we use the function******pinMode(pin, input)******to configure the pin.*

# On the Arduino Uno Board, see the picture above. There are 14 digital pins (numbered 0 to 13). Pins 0 and 1 (named RX and TX) are for serial connection and should not be used for other uses. If 14 digital pins are not enough, you can always use the analog pins as digital pins.

# The digital pins on an Arduino Board have two states: off and on. If voltage is flowing, the circuit will be on. If it is not flowing, the circuit is off.

# digitalWrite() is the command that tells the pin to be on or off. This can be useful, for instance, to turn an LED on or off.

## *Analog Pins*

# *Unlike a digital value, which is on or off, analog values have multiple readings. For example, the volume settings on your mobile. It is not just on or off, but it can have a range of values between on and off. Arduino uses a function named analogRead to get the sensor value proportional to the voltage it sees on the analog pin.The value will be 0 if there are 0 volts on the pin and the value will be 1023 if there are 5 volts on the pin. The value in between will be proportional. So 2.5 volts will give a value of 511. On the Arduino Uno Board, there are six analog pins (numbered from 0 to 5). Remember, these pins can also be used as digital pins. In the upcoming tutorials, we will see how we can adjust the voltage on a pin manually or by sensing the environment from the sensor*

# *2.RASPBERRY PI:*

# *The Raspberry Pi is a low cost,****credit-card sized computer****that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It’s capable of doing everything you’d expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.*

## *What’s more, the Raspberry Pi  has the ability to interact with the outside world, and has been used in a wide array of digital maker projects, from music machines and parent detectors to weather stations and tweeting birdhouses with infra-red cameras. We want to see the Raspberry Pi being used by kids all over the world to learn to program and understand how computers work.*

# *3. JUMPER WIRE*

## *Jumper wire" redirects here. For wire bridges, see*[*jumper*](https://en.wikipedia.org/wiki/Jumper_(computing))*. For fly-wires, see*[*enameled wire*](https://en.wikipedia.org/wiki/Enameled_wire)*. For patch leads, see*[*patch cable*](https://en.wikipedia.org/wiki/Patch_cable)*.*

## *A jump wire (also known as jumper, jumper wire, DuPont wire) is an*[*electrical wire*](https://en.wikipedia.org/wiki/Electrical_wire)*, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a*[*breadboard*](https://en.wikipedia.org/wiki/Breadboard)*or other prototype or test circuit, internally or with other equipment or components, without soldering.*[*[1]*](https://en.wikipedia.org/wiki/Jump_wire#cite_note-1)

## *Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the*[*header connector*](https://en.wikipedia.org/wiki/Pin_header#Header_connector)*of a circuit board, or a piece of test equipment.*

# *4.ULTRASONIC SENSOR*

## *An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).*

## *In order to calculate the distance between the sensor and the object, the sensor measures the time it takes between the emission of the sound by the transmitter to its contact with the receiver. The formula for this calculation is*[*D = ½ T x C*](https://www.arrow.com/en/research-and-events/articles/ultrasonic-sensors-how-they-work-and-how-to-use-them-with-arduino)*(where D is the distance, T is the time, and C is the speed of sound ~ 343 meters/second). For example, if a scientist set up an ultrasonic sensor aimed at a box and it took 0.025 seconds for the sound to bounce back, the distance between the ultrasonic sensor and the box would be:*

|  |
| --- |
| *D = 0.5 x 0.025 x 343* |

## *or about 4.2875 meters.*

# *5.TEMPERATURE SENSOR*

## *A temperature sensor is a device, typically, a thermocouple or resistance temperature detector, that provides temperature measurement in a readable form through an electrical signal.*

## *A thermometer is the most basic form of a temperature meter that is used to measure the degree of hotness and coolness.*

## *Temperature meters are used in the geotechnical field to monitor concrete, structures, soil, water, bridges etc. for structural changes in them due to seasonal variations.A thermocouple (T/C) is made from two dissimilar metals that generate an electrical voltage in direct proportion with the change in temperature. An RTD (Resistance Temperature Detector) is a variable resistor that changes its electrical resistance in direct proportion with the change in the temperature in a precise, repeatable and nearly linear manner.*

## *What do temperature sensors do?*

## *A temperature sensor is a device that is designed to measure the degree of hotness or coolness in an object. The working of a temperature meter depends upon the voltage across the diode. The temperature change is directly proportional to the diode’s resistance. The cooler the temperature, lesser will be the resistance, and vice-versa.*

## *The resistance across the diode is measured and converted into readable units of temperature (Fahrenheit, Celsius, Centigrade, etc.) and, displayed in numeric form over readout units. In geotechnical monitoring field, these temperature sensors are used to measure the internal temperature of structures like bridges, dams, buildings, power plants, etc.*

# *6.BREADBOARD*

## *A breadboard is a rectangular plastic board with a bunch of tiny holes in it. These holes let you easily insert electronic components to prototype (meaning to build and test an early version of) an electronic circuit, like this one with a battery, switch, resistor, and an LED (light-emitting diode). To learn more about individual electronic components, see our*[*Electronics Primer*](https://www.sciencebuddies.org/science-fair-projects/references/electronics-primer-introduction)*.*

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## *The connections are not permanent, so it is easy to remove a component if you make a mistake, or just start over and do a new project. This makes breadboards great for beginners who are new to electronics.*

## *You can use breadboards to make all sorts of fun electronics projects, from different types of robots or an electronic drum set, to an electronic rain detector to help conserve water in a garden, just to name a few.*

# *****7.PIR SENSOR*****

## *****What is a PIR Sensor?*****

## *A passive infrared sensor is an electronic sensor that measures infrared light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. PIR sensors are commonly used in security alarms and automatic lighting applications.*

## *Image: PIR Motion Sensor – Large Lens version*

## *Technically, PIR is made of a pyroelectric sensor, which is able to detect different levels of infrared radiation. For example, Everything emits varied level radiation and the level of radiation will increase with the increase of the object’s temperature.*

## *****What does a PIR sensor detect?*****

## *PIR sensors are also known as PID or Passive Infrared Detectors. Thus, the PIR sensor can detect infrared radiation that is emitted by particles.*

## *Generally, PIR can detect animal/human movement in a requirement range, which is determined by the spec of the specific sensor. The detector itself does not emit any energy but passively receives it, detects infrared radiation from the environment.*

# *8.BUZZER*

## *What is a Buzzer?*

## *An audio signaling device like a beeper or buzzer may be electromechanical or*[*piezoelectric*](https://www.elprocus.com/what-is-a-piezoelectric-material-working/)*or mechanical type. The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren.*

## *The******pin configuration of the buzzer******is shown below. It includes two pins namely positive and negative. The positive terminal of this is represented with the ‘+’ symbol or a longer terminal. This terminal is powered through 6Volts whereas the negative terminal is represented with the ‘-‘symbol or short terminal and it is connected to the GND terminal.*

# *9.RESISTOR*

## *A resistor is a*[*passive*](https://en.wikipedia.org/wiki/Passivity_(engineering))[*two-terminal*](https://en.wikipedia.org/wiki/Terminal_(electronics))[*electrical component*](https://en.wikipedia.org/wiki/Electronic_component)*that implements*[*electrical resistance*](https://en.wikipedia.org/wiki/Electrical_resistance)*as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to*[*divide voltages*](https://en.wikipedia.org/wiki/Voltage_divider)*,*[*bias*](https://en.wikipedia.org/wiki/Biasing)*active elements, and terminate*[*transmission lines*](https://en.wikipedia.org/wiki/Transmission_line)*, among other uses. High-power resistors that can dissipate many*[*watts*](https://en.wikipedia.org/wiki/Watt)*of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test loads for*[*generators*](https://en.wikipedia.org/wiki/Electric_generator)*. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.*

## *Resistors are common elements of*[*electrical networks*](https://en.wikipedia.org/wiki/Electrical_network)*and*[*electronic circuits*](https://en.wikipedia.org/wiki/Electronic_circuit)*and are ubiquitous in*[*electronic equipment*](https://en.wikipedia.org/wiki/Electronics)*. Practical resistors as discrete components can be composed of various compounds and forms. Resistors are also implemented within*[*integrated circuits*](https://en.wikipedia.org/wiki/Integrated_circuits)*.*

## *The electrical function of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine*[*orders of magnitude*](https://en.wikipedia.org/wiki/Orders_of_magnitude)*. The nominal value of the resistance falls within the*[*manufacturing tolerance*](https://en.wikipedia.org/wiki/Engineering_tolerance#Electrical_component_tolerance)*, indicated on the component.*

# *****10.LED:*****

# ***LED****, in full****light-emitting diode****, in*[*electronics*](https://www.britannica.com/technology/electronics)*, a*[*semiconductor device*](https://www.britannica.com/technology/semiconductor-device)*that*[*emits*](https://www.britannica.com/dictionary/emits)*infrared or visible light when charged with an*[*electric current*](https://www.britannica.com/science/electric-current)*. Visible LEDs are used in many electronic devices as indicator lamps, in automobiles as rear-window and brake lights, and on billboards and signs as alphanumeric displays or even full-colour posters. Infrared LEDs are employed in autofocus cameras and television remote controls and also as light sources in fibre-optic*[*telecommunication*](https://www.britannica.com/technology/telecommunication)*systems.*

## *The familiar*[*lightbulb*](https://www.britannica.com/technology/lightbulb)*gives off light through incandescence, a phenomenon in which the heating of a*[*wire*](https://www.britannica.com/technology/wire)*filament by an electric current causes the wire to emit photons, the basic*[*energy*](https://www.britannica.com/science/energy)*packets of light. LEDs operate by*[*electroluminescence*](https://www.britannica.com/science/electroluminescence)*, a phenomenon in which the emission of photons is caused by electronic excitation of a material. The material used most often in LEDs is*[*gallium arsenide*](https://www.britannica.com/science/gallium-arsenide)*, though there are many variations on this basic*[*compound*](https://www.merriam-webster.com/dictionary/compound)*, such as aluminum gallium arsenide or aluminum gallium indium phosphide. These*[*compounds*](https://www.merriam-webster.com/dictionary/compounds)*are members of the so-called III-V group of semiconductors—that is,*[*compounds*](https://www.britannica.com/science/III-V-compound)*made of elements listed in columns III and V of the*[*periodic table*](https://www.britannica.com/science/periodic-table)*. By varying the precise*[*composition*](https://www.merriam-webster.com/dictionary/composition)*of the*[*semiconductor*](https://www.britannica.com/science/semiconductor)*, the wavelength (and therefore the colour) of the emitted light can be changed.*

## *LED emission is generally in the visible part of the spectrum (i.e., with wavelengths from 0.4 to 0.7 micrometre) or in the near infrared (with wavelengths between 0.7 and 2.0 micrometres). The brightness of the light observed from an LED depends on the power emitted by the LED and on the relative sensitivity of the eye at the emitted wavelength. Maximum sensitivity occurs at 0.555 micrometre, which is in the yellow-orange and green region. The applied voltage in most LEDs is quite low, in the region of 2.0 volts; the current depends on the application and ranges from a few milliamperes to several hundred milliamperes.*

# *11.SERVOMOTORS*

### *A servomotor (or servo motor) is a*[*rotary actuator*](https://en.wikipedia.org/wiki/Rotary_actuator)*or*[*linear actuator*](https://en.wikipedia.org/wiki/Linear_actuator)*that allows for precise control of angular or linear position, velocity and acceleration.*[*[1]*](https://en.wikipedia.org/wiki/Servomotor#cite_note-1)*It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.*

### *Servomotors are not a specific class of motor, although the term servomotor is often used to refer to a motor suitable for use in a*[*closed-loop control*](https://en.wikipedia.org/wiki/Closed-loop_control)*system.*

### *Servomotors are used in applications such as*[*robotics*](https://en.wikipedia.org/wiki/Robotics)*,*[*CNC machinery*](https://en.wikipedia.org/wiki/CNC_machine)*, and*[*automated manufacturing*](https://en.wikipedia.org/wiki/Automated_manufacturing)*.*