Al-Mustaqbal University
Department of Medical Instrumentation Techniques Engineering
Class: four
Subject: Advanced logic design
Lecturer: Dr. Zahraa hashim kareem
Lecture- 1: Introduction to Arduino

1. introduction to Arduino

Arduino was introduced back in 2005 in Italy by Massimo Banzi as a way for non-engineers 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. and the most features of Arduino are as follows:

- **Educational Use**: Arduino is widely used in educational programs globally, especially by designers and artists for prototyping without needing deep technical knowledge.
- **Ease of Use**: Designed for non-technical users, with example codes provided to demonstrate how to use the board's features.
- **Sophisticated Hardware**: While simple to use, Arduino's hardware operates at a professional level, similar to what engineers use in embedded systems.
- **Agile Development**: Microcontroller users appreciate Arduino for its quick idea implementation and fast development capabilities.
- **Hardware and Software**: Arduino refers to both the hardware (boards) and software (programming interface), which work together to create interactive projects.
- **Open Source**: The software is free, cross-platform, and open source, and the hardware designs are also open source, allowing users to build their own boards.
- **Cost-Effective**: Arduino boards are affordable, making them accessible for a wide range of users.
- **Active Community**: Arduino has a large, supportive community worldwide through forums and the Arduino Playground (wiki), providing project examples and solutions.
- **Project Variety**: Arduino enables users to build objects that can control and respond to light, sound, touch, and movement.

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- **Creative Applications**: It has been used to create musical instruments, robots, games, light sculptures, interactive furniture, and even wearable tech.

2. **The most popular Arduino types**

1. Arduino UNO
2. Arduino Nano
3. Arduino Mega 2560
4. Arduino Leonardo
5. Arduino Micro
6. Arduino Due
7. Arduino Pro Mini
8. Arduino Zero
9. Arduino MKR1000
10. Arduino MKR GSM 1400
11. Arduino MKR WAN 1300
12. Arduino MKR WiFi 1010
13. Arduino MKR FOX 1200
14. Arduino MKR NB 1500
15. Arduino LilyPad
16. Arduino Yún
17. Arduino Nano 33 IoT
18. Arduino Nano 33 BLE
19. Arduino Portenta H7
20. Arduino Esplora

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3. Arduino environment

- Arduino software

Software programs, called **sketches**, are created on a computer using the Arduino **integrated development environment (IDE).** The IDE enables you to write and edit code and convert this code into instructions that Arduino hardware understands. The IDE also transfers those instructions to the Arduino board (a process called uploading).

- Arduino hardware

The Arduino board is where the code you write is executed. The board can only control and respond to electricity, so specific components are attached to it to enable it to interact with the real world. These components can be sensors, which convert some aspect of the physical world to electricity so that the board can sense it, or actuators, which get electricity from the board and convert it into something that changes the world. Examples of sensors include switches, accelerometers, and ultrasound distance sensors. Actuators are things like lights and LEDs, speakers, motors, and displays.

Arduino hardware consists of a variety of components, primarily the **microcontroller boards** themselves, as well as other accessories and shields that enhance their functionality. Here's a brief overview of the key elements:

1. **Arduino Boards (Microcontrollers)**

- **Main Boards**: These are the core hardware of Arduino, containing a programmable microcontroller.
  - Examples: Arduino UNO, Arduino Nano, Arduino Mega, Arduino Leonardo, etc.

2. **Shields**

- **Expansion Boards**: Shields are plug-in modules that add extra capabilities to an Arduino board, such as connectivity or sensor interfaces.

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- Examples: Ethernet Shield, Motor Shield, Wi-Fi Shield, GSM Shield.

3. **Sensors**

- **Input Devices**: Sensors capture data from the environment (temperature, humidity, motion, etc.) for the Arduino to process.
- Examples: Ultrasonic sensors, temperature sensors, light sensors, infrared sensors.

4. **Actuators**

- **Output Devices**: Actuators receive commands from the Arduino to perform actions such as movement or lighting up.
- Examples: Motors, servos, LEDs, speakers.

5. **Breadboards & Jumper Wires**

- **Prototyping Tools**: Used for building and testing circuits without soldering. Breadboards are where components are connected using jumper wires.

6. **Power Supply**

- **External Power**: Arduino boards can be powered by USB, battery, or external power adapters.
- Voltage typically ranges from 5V (USB) to 9V-12V (external).

7. **USB Cables**

- **Programming & Power**: Used to connect the Arduino board to a computer for programming and also to power the board.

8. **LCDs & Displays**

- **Output Devices**: Display information such as text, numbers, or graphics.
- Examples: 16x2 LCD, OLED displays, TFT touchscreens.

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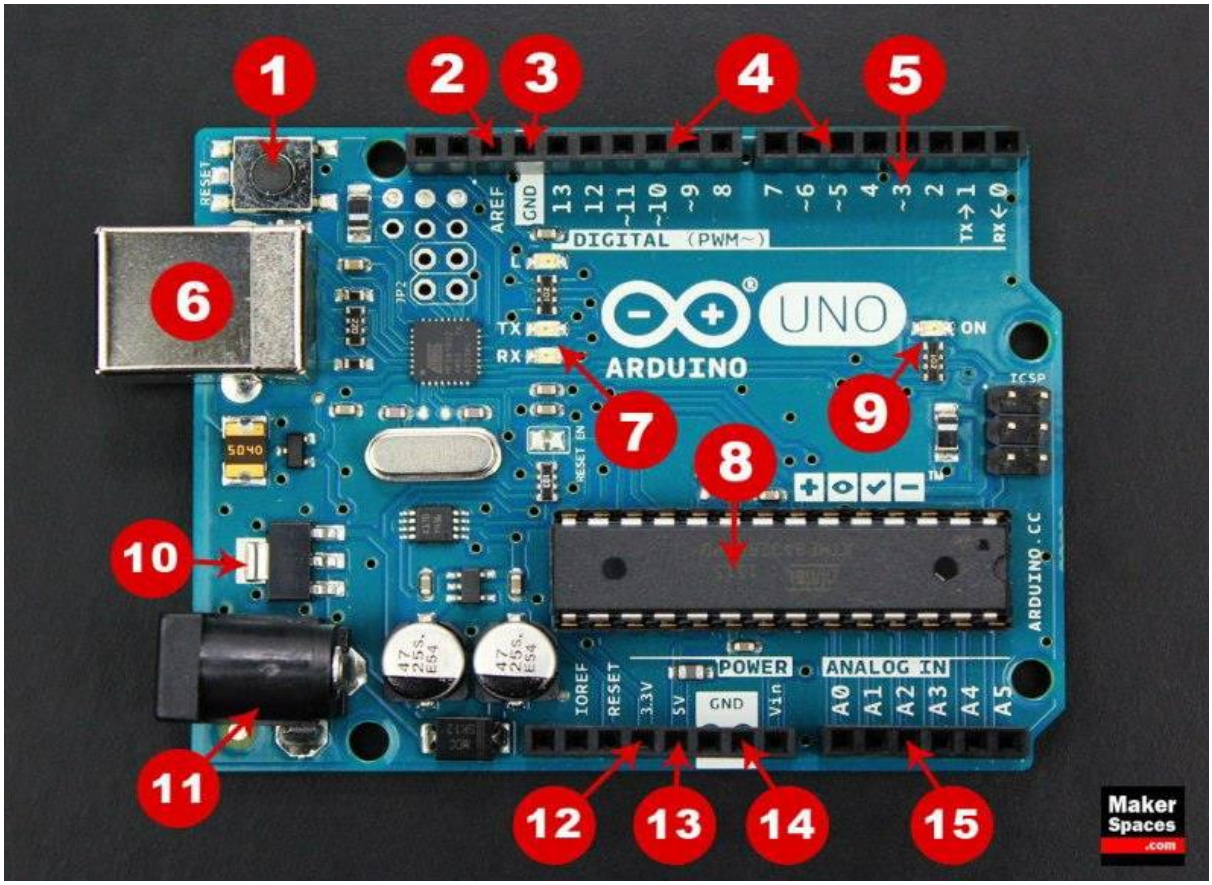
9. **Modules**

- **Additional Functionality**: Modules can be attached for specific functions like GPS, Bluetooth, Wi-Fi, etc.
  - Examples: Bluetooth modules, GSM modules, GPS modules.

10. **Proto Shields**

- **Custom Shield Creation**: Blank shields that can be customized for creating your own hardware extensions.

These components work together to help users create interactive electronics projects with ease, making Arduino a versatile tool for makers, hobbyists, and engineers.



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Board Breakdown

Here are the components that make up an Arduino board and what each of their functions are.

1. **Reset Button** – This will restart any code that is loaded to the Arduino board
2. **AREF** – Stands for "Analog Reference" and is used to set an external reference voltage
3. **Ground Pin** – There are a few ground pins on the Arduino and they all work the same
4. **Digital Input/Output** – Pins 0-13 can be used for digital input or output
5. **PWM** – The pins marked with the (~) symbol can simulate analog output
6. **USB Connection** – Used for powering up your Arduino and uploading sketches
7. **TX/RX** – Transmit and receive data indication LEDs
8. **ATmega Microcontroller** – This is the brains and is where the programs are stored
9. **Power LED Indicator** – This LED lights up anytime the board is plugged in a power source
10. **Voltage Regulator** – This controls the amount of voltage going into the Arduino board
11. **DC Power Barrel Jack** – This is used for powering your Arduino with a power supply
12. **3.3V Pin** – This pin supplies 3.3 volts of power to your projects
13. **5V Pin** – This pin supplies 5 volts of power to your projects
14. **Ground Pins** – There are a few ground pins on the Arduino and they all work the same
15. **Analog Pins**

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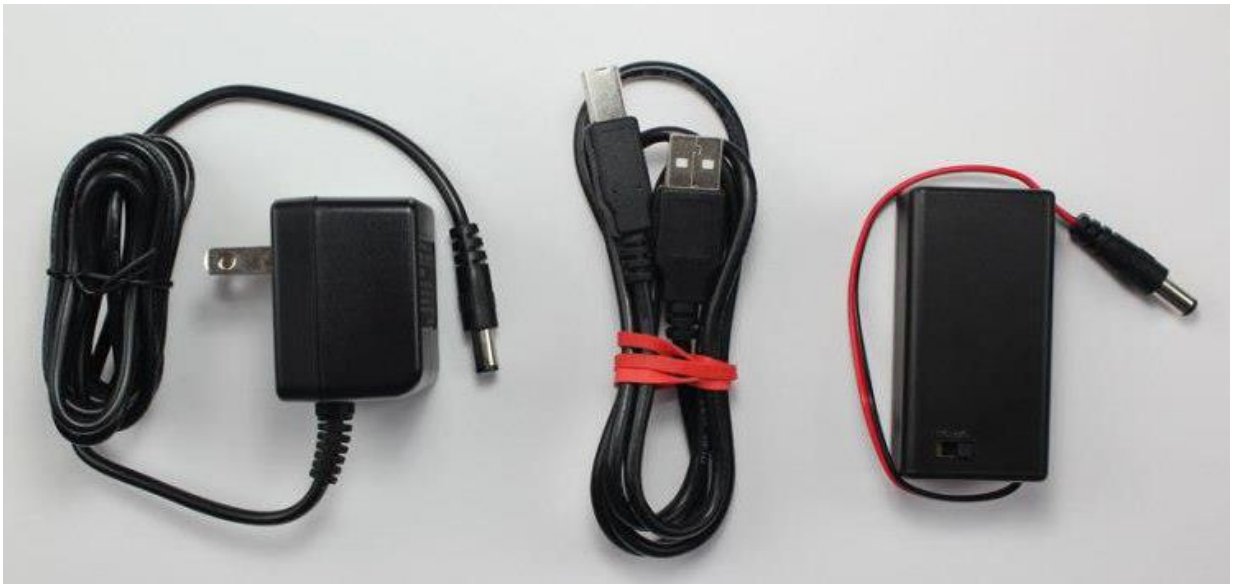
4. Arduino Power Supply

The Arduino Uno needs a power source in order for it to operate and can be powered in a variety of ways. You can do what most people do and connect the board directly to your computer via a USB cable. If you want your project to be mobile, consider using a 9V battery pack to give it juice. The last method would be to use a 9V AC power supply.



5. Arduino Breadboard

Another very important item when working with Arduino is a solderless breadboard. This device allows you to prototype your Arduino project without having to permanently solder the circuit together. Using a breadboard allows you to create temporary prototypes and experiment with different circuit designs. Inside the holes (tie points) of the plastic housing, are metal clips which are connected to each other by strips of conductive material. On a side note, the breadboard is not powered on its own and needs power brought to it from the Arduino board using jumper wires. These wires are also used to form the circuit by connecting resistors, switches and other components together.

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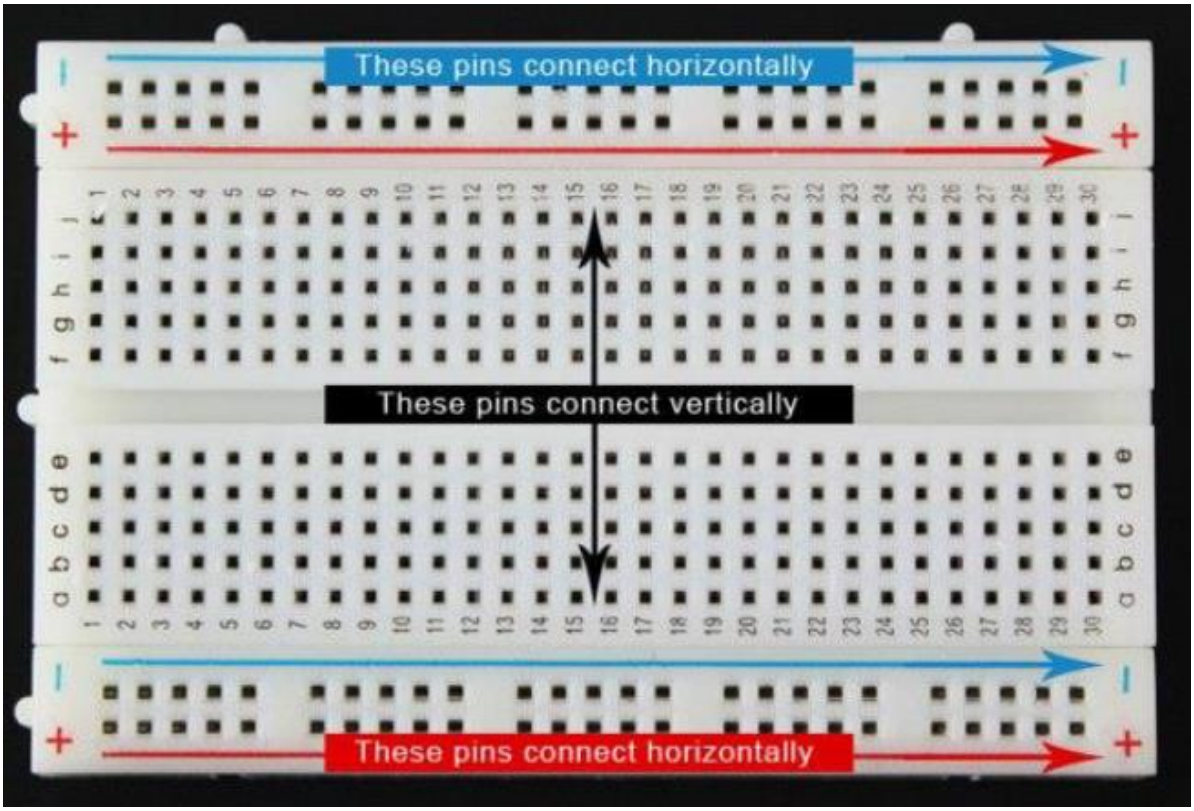
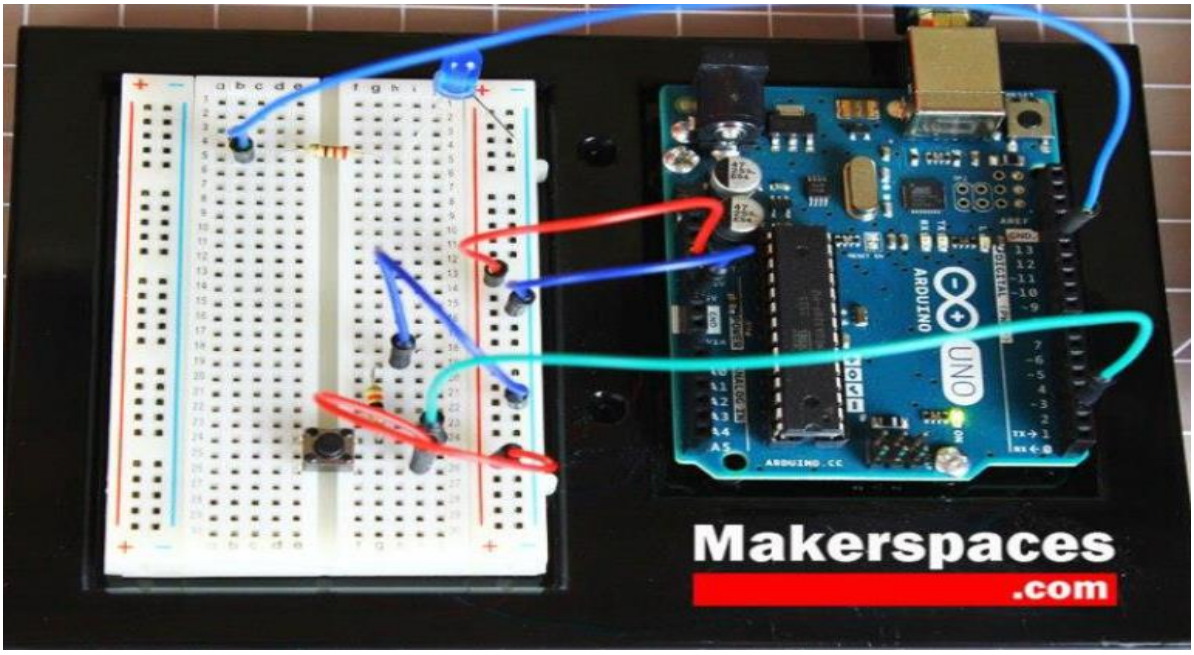


Here is a visual of what a completed Arduino circuit looks like when connected to a breadboard.



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