



HARDWARE PARTS

ECTE250 Lab 2

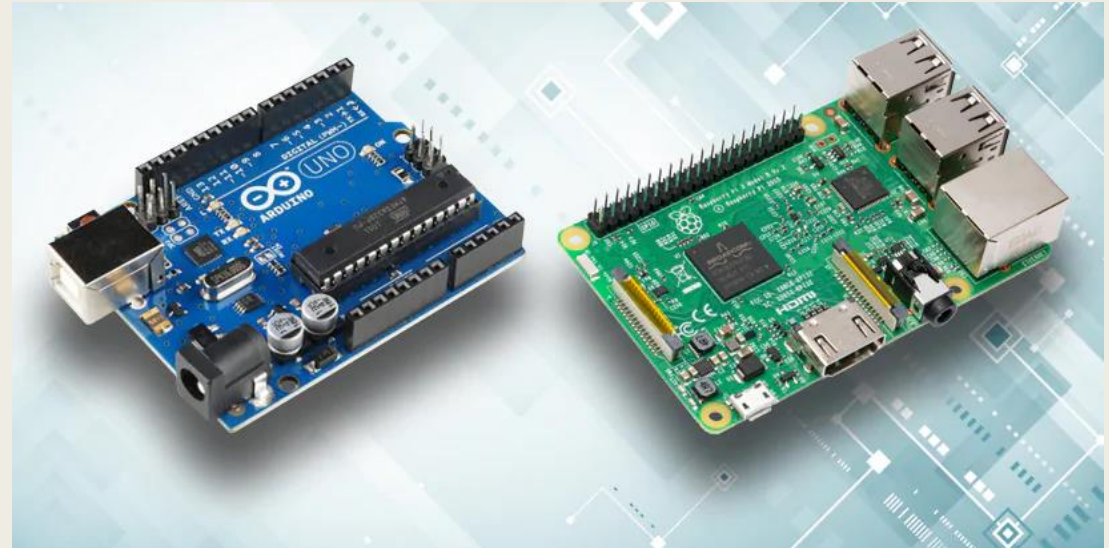


Contents

- Main boards
- Sensors
- Actuators (Motors)
- Communication
- Other

Selecting a processor

- Processing power
- Speed
- Cost
- Language and frame work



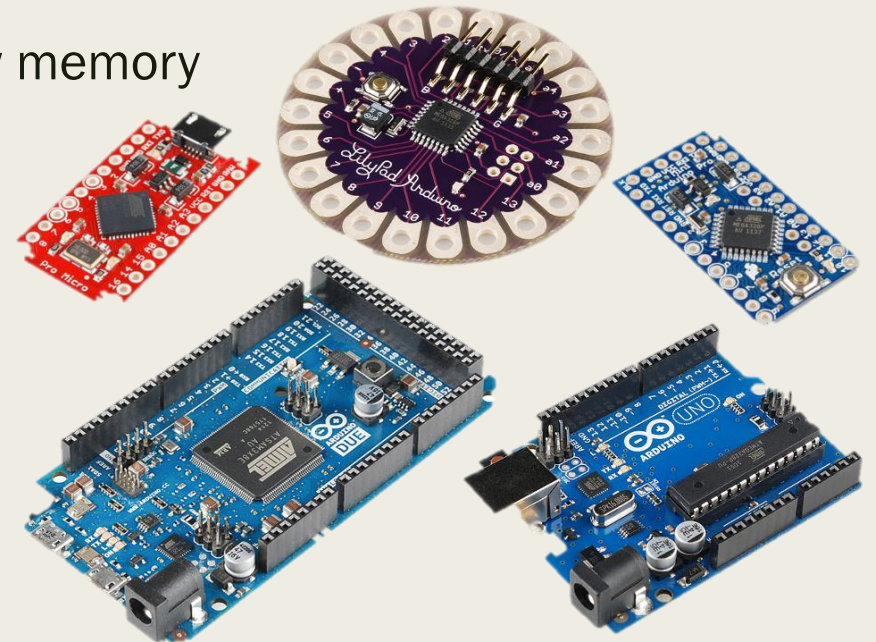
Arduino

Advantages:

- Relatively Inexpensive
- Open source
- Rich community
- Analog GPIO
- Many clones with enhancements

Disadvantages:

- Slow
- Low processing power
- Low memory



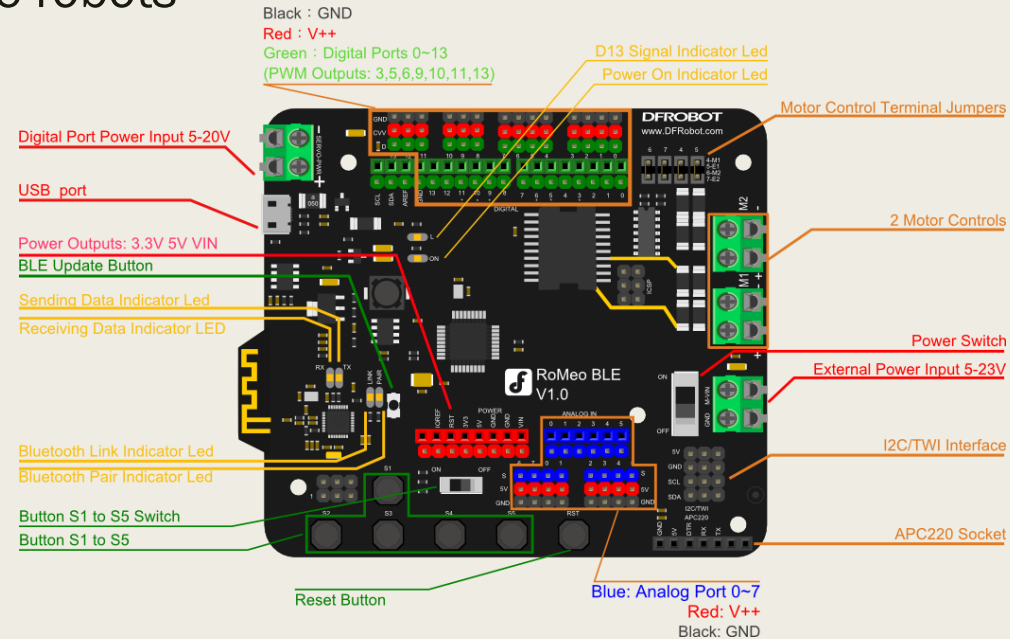
Arduino models

- UNO: Basic, easy to use, no additional shields
- Nano: Small, portable
- Mega: Larger memory, more pins
- Lilypad: Textile applications
- IoT and Wifi Boards
- List of all:
arduino.cc/en/Main/Products

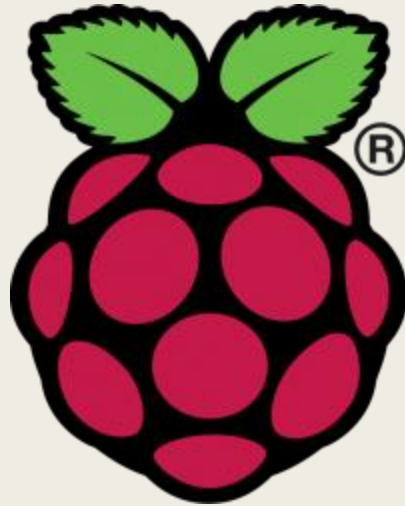
Boards	Microcontroller	Operating Voltage/s (V)	Digital I/O Pins	PWM Enabled Pins	Analog I/O Pins	DC per I/O (mA)	Flash Memory (KB)	SRAM (KB)	EEPROM (KB)	Clock (MHz)	Length (mm)	Width (mm)	Cable	Native Network Support
Uno	ATmega328	5	14	6	6	20	32	2	1	16	68.6	53.4	USB A-B	None
Leonardo	ATmega32u4	5	20	7	12	40	32	2.5	1	16	68.6	53.3	micro-USB	None
Micro	ATmega32u4	5	20	7	12	40	32	2.5	1	16	48	18	micro-USB	None
Nano	ATmega328	5	22	6	8	40	32	2	0.51	16	45	18	mini-B USB	None
Mini	ATmega328	5	14		6	20	32	2	1	16	30	18	USB-Serial	None
Due	Atmel SAM3X8E ARM Cortex-M3 CPU	3.3	54	12	12	800	512	96	X	84	102	53.3	micro-USB	None
Mega	ATmega2560	5	54	15	16	20	256	8	4	16	102	53.3	USB A-B	None
M0	Atmel SAMD21	3.3	20	12	6	7	256	32	X	48	68.6	53.3	micro-USB	None
Yun Mini	ATmega32u4	3.3	20	7	12	40	32	2.5	1	400	71.1	23	micro-USB	Ethernet/Wifi
Uno Ethernet	ATmega328p	5	20	4	6	20	32	2	1	16	68.6	53.4	Ethernet	Ethernet
Tian	Atmel SAMD21	5	20	12	0	7	16000	64000	X	560	68.5	53	micro-USB	Ethernet/Wifi
Mega ADK	ATmega2560	5	54	15	16	40	256	8	4	16	102	53.3	USB A-B	None
M0 Pro	Atmel SAMD21	3.3	20	12	6	7	256	32	X	48	68.6	53.3	micro-USB	None
Industrial 101	ATmega32u4	5	7	2	4	40	16000	64000	1	400	51	42	micro-USB	Ethernet/Wifi
Uno Wifi	ATmega328	5	20	6	6	20	32	2	1	16	68.6	53.4	USB A-B	Wifi
Leonardo Ethernet	ATmega32u4	5	20	7	12	40	32	2.5	1	16	68.6	53.3	USB A-B	Ethernet
MKR1000	Atmel SAMD21	3.3	8	12	7	7	256	32	X	48	64.6	25	micro-USB	Wifi

Arduino clones

- DFRobot: <https://www.dfrobot.com/>
- Romeo BLE v4: Embedded BLE, Embedded Motor driver and additional power pins, perfect for mobile robots



Raspberry pi



Advantages:

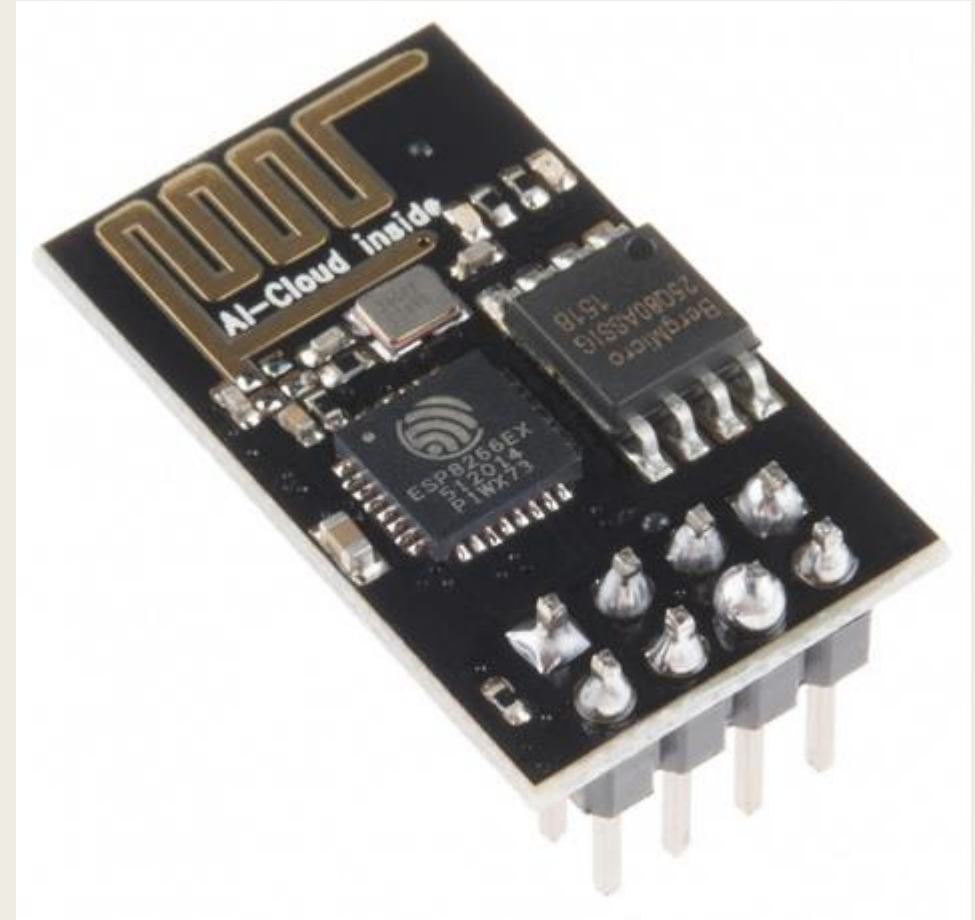
- Micro-computer
- Strong processing power
- Communication

Disadvantages:

- Expensive
- Requires OS
- No analog input

Other boards

- ESP: WiFi embedded boards
- Teensy: Arduino compatible
- Particle: Bluetooth ready boards
- Jetson: Made for AI, Deep learning



Sensors

Analog

- Light Sensor (LDR)
- Temperature Sensor
- Heart rate sensor
- Pressure Sensor

Digital

- IR sensor
- Push button
- Ultrasonic
- Motion sensor

Motors

DC Motor

- Continuous rotation motor
- Fast
- Used as wheels or fan
- Speed is controlled via PWM



Servo Motor

- Consists of: a DC motor, control unit, position sensor and gearing unit.
- Can be used as a sensor to read the current angle/position
- Slower but more precise
- Half and full rotation



Stepper motor

- Servo with a different control method
- Slowest motor
- Most precise
- Used when position is fundamental



Motor selection

Motor Type	Advantages	Disadvantages	Use case
DC (Brushed)	<ul style="list-style-type: none">• High acceleration, highest speed• Low cost	<ul style="list-style-type: none">• Age issue	<ul style="list-style-type: none">• Mobile robots, locks
DC (Brushless)	<ul style="list-style-type: none">• High acceleration, highest speed• Last longer	<ul style="list-style-type: none">• Cost more	<ul style="list-style-type: none">• Drones• Humanoids
Stepper	<ul style="list-style-type: none">• Simple operation• Accurate position• High torque at low speed	<ul style="list-style-type: none">• Open loop• Low acceleration• More heat	<ul style="list-style-type: none">• Printers• CNC machines
Servo	<ul style="list-style-type: none">• Smooth operation• Closed loop• Higher acceleration	<ul style="list-style-type: none">• More complicated• Cost more	<ul style="list-style-type: none">• Robot arm• Dials• Positioning

Communication

All communications in real world are analog.

Wired:

- Electrical signal
- Light signal (Fiber optics)

Wireless:

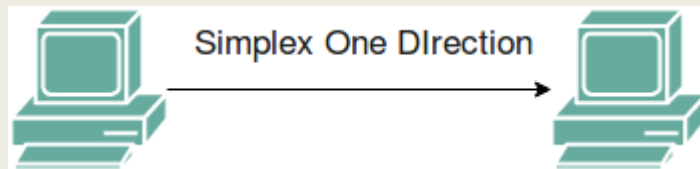
- Radio Frequency
- Infra-red
- Wi-Fi
- Bluetooth
- Li-Fi



Communication

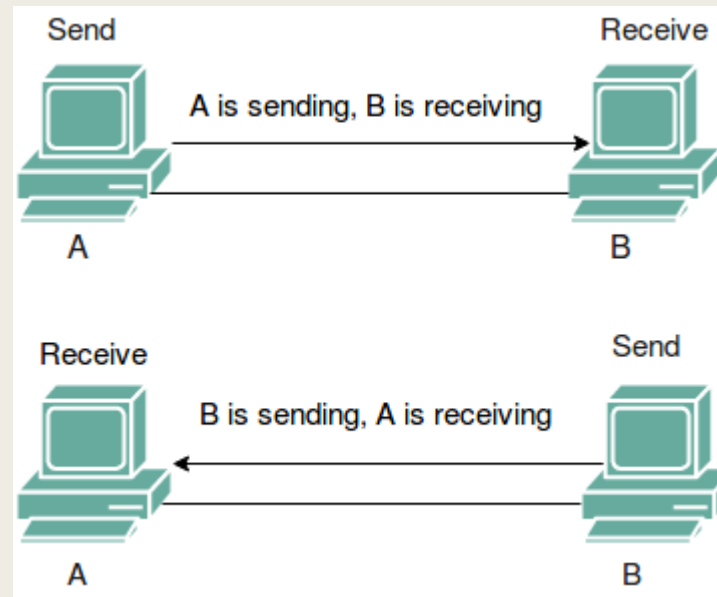
Simplex

- Only one way communication
- TV, Radio, keyboard



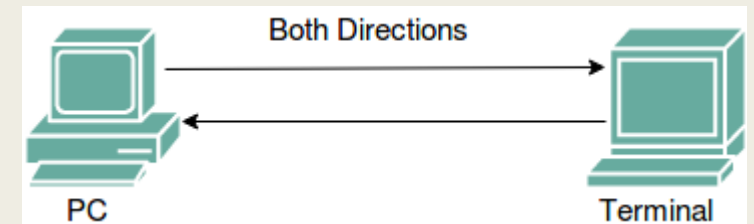
Half Duplex

- One at a time, both directions
- Walkie-talkie



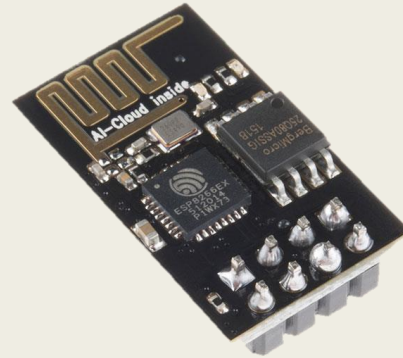
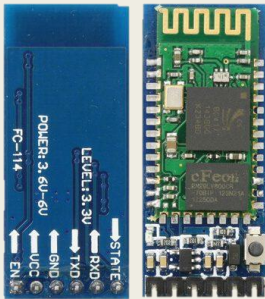
Full Duplex

- Both directions
- Skype, voice call, whatsapp



Communication for ECTE 250

- Wired: I2C, Serial Communication
- Wireless: nRf, Bluetooth, Wi-Fi, GSM, Li-Fi



List of websites for parts:

- www.dfrobot.com
- www.Zeroohm.com
- www.edwinrobotics.com
- www.noon.com
- www.amazon.ae
- www.blue-pcb.com
- www.besomi.net

Task for today

Implement and design a smart farming application, where you use the photoresistor for light, soil moisture and temperature to monitor the climate of a plot. These details should be shown on an I2C LCD. See example below:



It should display the following details according to the table below.

Description	Low	Normal	High
Light	<250	$250 < x < 700$	>700
Soil moisture	<200	$200 < x < 600$	>600
Temperature	<15 C	$15 < x < 35$	>35