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Power of digitalization in fighting against climate change

Arduino

Hexagonale Association

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Power of digitalization in fighting against climate change

Arduino

Introduction

Digital technology offers powerful tools to address climate change challenges.

This report explores how Arduino, an accessible electronic platform, enables students across Europe to create innovative environmental solutions.

Through seven country-specific projects, we demonstrate how simple technology can have meaningful environmental impact.

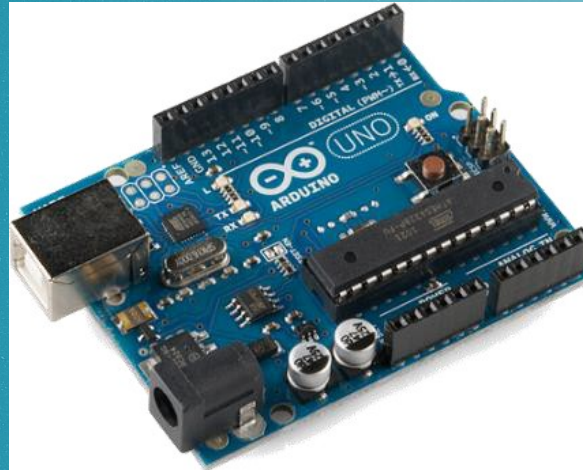
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Arduino

What is Arduino:

Arduino is a printed circuit board in **free hardware** (The plans of the board itself are accessible by everyone, for free) on which there is a **microcontroller (tiny computer)** that can be programmed to analyze and produce electrical signals (An electrical signal is a passage of electricity in a part of the circuit. Here the electricity produced by the arduino will always be 5V DC)

It usually looks like this



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Creative artists

They came from a design school near the city of Turin in Italy.

Their students could not give free rein to their creativity, too often, the level of electronics, programming and cost limited them to projects that were too simple.

But these creative artists have managed to create a link between the real and digital world.



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Arduino: a philosophy

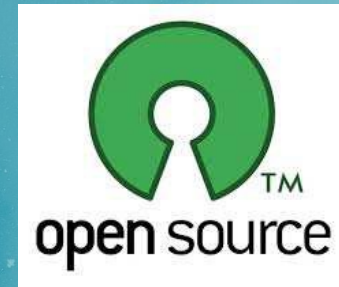
The hardware is open source:

- Can be copied, manufactured and modified Freely.



The software is free:

- It can be used and modified freely.



On the Internet, we find:

- A community of users.
- User guides.
- Examples : forums of mutual assistance.

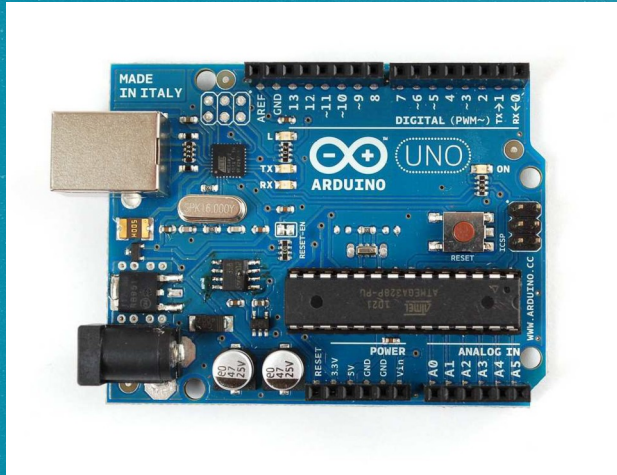


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Arduino

Arduino in summary

An electronic board



A community that exchanges <http://arduino.cc/>

Main Site: Blog Playground Forum Labs Store



Buy Download Getting Started Learning Reference Hardware FAQ



Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments.

Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the **Arduino programming language** (based on Wiring) and the **Arduino development environment** (based on Processing). Arduino projects can be stand-alone or they can communicate with software running on a computer (e.g. Flash, Processing, MaxMSP).

The boards can be **built by hand** or **purchased preassembled**; the software can be **downloaded** for free. The hardware reference designs (CAD files) are **available** under an open-source license, you are free to **adapt them to your needs**.

Photo by the Arduino Team

An environment of programming

```
Blink | Arduino 1.0
File Edit Sketch Tools Help
Blink
/*
 * Blink
 * Turns on an LED on for one second, then off for one second, repeatedly.
 * This example code is in the public domain.
 */

void setup() {
  // initialize the digital pin as an output.
  // Pin 13 has an LED connected on most Arduino boards:
  pinMode(13, OUTPUT);
}

void loop() {
  digitalWrite(13, HIGH); // set the LED on
  delay(1000);           // wait for a second
  digitalWrite(13, LOW); // set the LED off
  delay(1000);          // wait for a second
}

1 Arduino Uno on /dev/ttyACM0
```

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Arduino is very popular

Arduino has become popular worldwide because:

Easy to learn: Simple programming language suitable for beginners

Affordable: Basic kits cost around €20-30

Creative: Can be used for countless applications

Educational: Teaches electronics, programming, and problem-solving

Community-supported: Extensive online resources and examples

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Benefits for Students and Schools

Arduino provides exceptional educational value, particularly for students aged 13-18:

Hands-on learning: Students create working devices that solve real problems

Cross-disciplinary: Combines science, technology, engineering, mathematics, and even arts

Collaborative: Encourages teamwork and knowledge sharing

Future-focused: Develops digital skills essential for tomorrow's careers

Inclusive: Accessible to students with different learning styles and abilities

Motivating: Immediate results keep students engaged and interested

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Area of use

Physical computing: building physical systems interactive applications that use software and hardware that can interface with **sensors and actuators.**

Industrial and embedded electronics

Art / Spectacle

Home automation

Robotics

Modelling

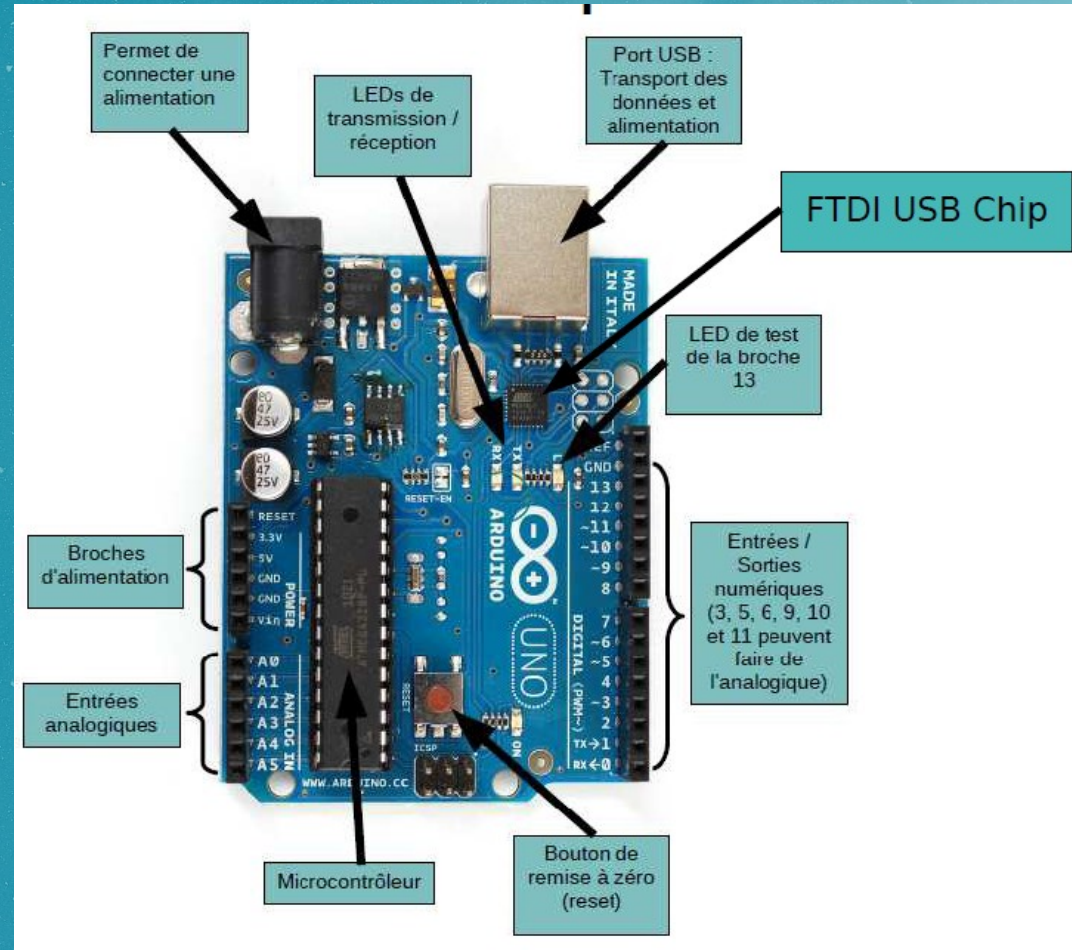
DIY (Do-It-Yourself), Hacker,

Education, etc.

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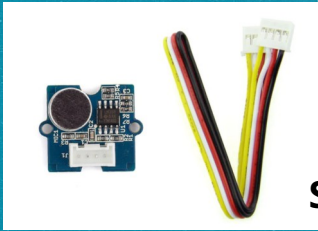
The Arduino electronic board



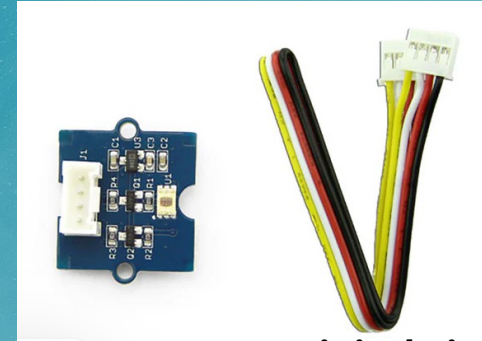
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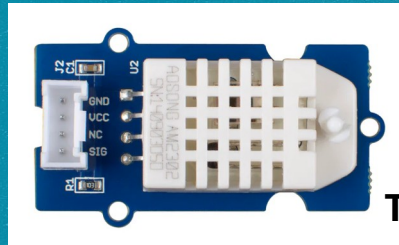
Examples of sensors



Sound Sensor



Digital Light Sensor



Temperature & Humidity Sensor



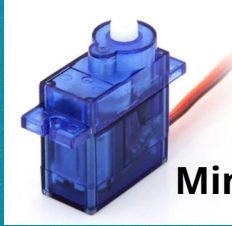
Air quality sensor

The sensors provide information so they connect directly to the inputs and this without soldering using a connector.

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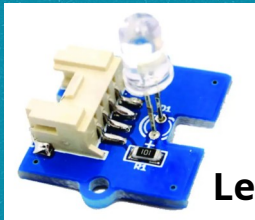
Examples of actuators



Mini Servo motor 120 degrees



Buzzer



Led



LCD display

The actuators receive an electrical signal to act if the software requests it. They are connected directly to the **output pins**.

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1. Let's program our Arduino

The strength of the Arduino is to offer us the microcontroller, I/O, connectivity and power supply on a single board. The Arduino board is built around a microcontroller

The Arduino is therefore a board that **connects to the computer to be programmed**, and **can then operate on its own if it is supplied with energy**. It allows to receive information and transmit from or to electronic equipment: diodes, potentiometers, receivers, servomotors, motors, detectors... The Arduino is therefore able to produce or pick up these signals at our request through programming.

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2. Let's program our Arduino

The Arduino language is based on C/C++.

In high schools, students generally use language c.

For students aged 11 to 14 cannot understand these languages, we use interfaces that allow programming in graphic form using blocks.

To program the Arduino UNO board, we use the Vittascience interface, available at:
<https://fr.vittascience.com/arduino/>

3. Let's program our Arduino

vitta science

Programming AI^{NEW} Resources Classroom Hardware

Nouveau projet

Upload

Search a block

- Display
- Inputs/Outputs
- Communication
- Sensors
- Actuators
- Robots
- AI cameras
- Logic

On start

Forever

- [Arduino] set built-in LED (D13) to state HIGH (1)
- wait 1 second(s)
- [Arduino] set built-in LED (D13) to state LOW (0)
- wait 1 second(s)

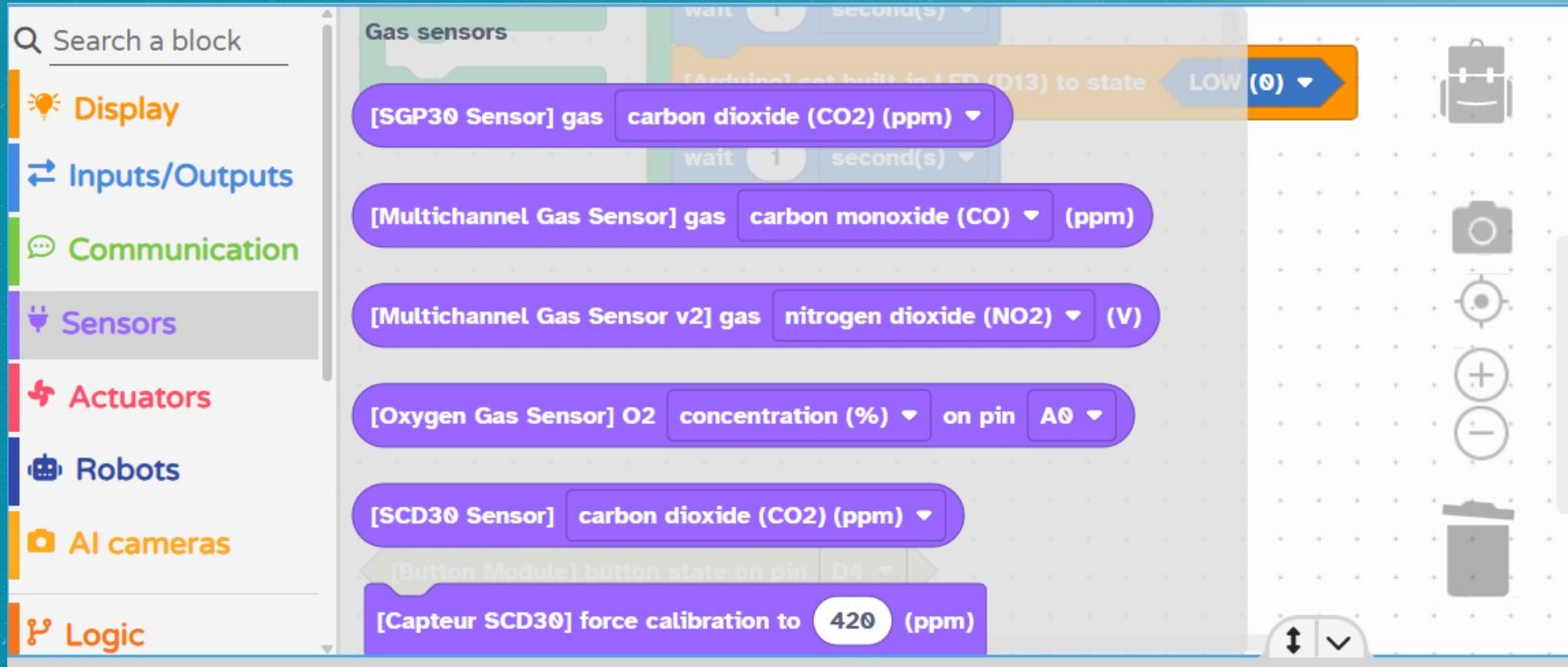
```
1 void setup() {
2   pinMode(13, OUTPUT);
3 }
4
5 void loop() {
6   digitalWrite(13, HIGH);
7   delay(1000*1);
8   digitalWrite(13, LOW);
9   delay(1000*1);
10 }
```

Welcome to the Vittascience interface for Arduino!
Vous pouvez consulter le tutorial disponible ici : [Getting Started with the Vittascience Interface for the Arduino UNO board](#)

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3. Let's program our Arduino



The image shows the Scratch environment for programming an Arduino. On the left, a sidebar contains a search bar and several category tabs: Display, Inputs/Outputs, Communication, Sensors, Actuators, Robots, AI cameras, and Logic. The main workspace is filled with a sequence of purple blocks from the 'Sensors' category. The blocks are as follows:

- [SGP30 Sensor] gas carbon dioxide (CO₂) (ppm) ▾
- [Multichannel Gas Sensor] gas carbon monoxide (CO) ▾ (ppm)
- [Multichannel Gas Sensor v2] gas nitrogen dioxide (NO₂) ▾ (V)
- [Oxygen Gas Sensor] O₂ concentration (%) ▾ on pin A0 ▾
- [SCD30 Sensor] carbon dioxide (CO₂) (ppm) ▾
- [Capteur SCD30] force calibration to 420 (ppm)

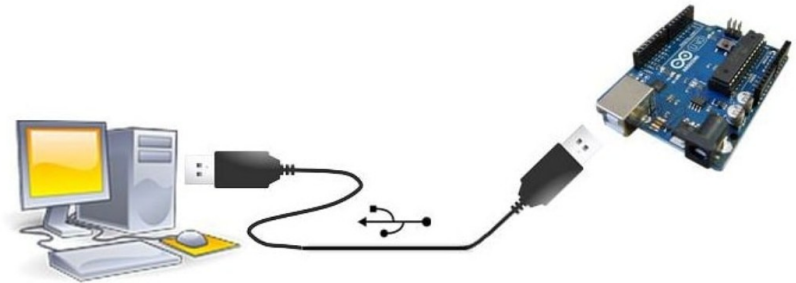
At the top of the workspace, there is a blue block: [Arduino] set built-in LED (D13) to state LOW (0) ▾. The workspace also shows some greyed-out blocks from other categories, such as 'wait 1 second(s)' and '(Button Module) button state on pin D4 ▾'. On the right side, there is a vertical toolbar with icons for a backpack, a camera, a robot, a plus sign, a minus sign, and a trash can.

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4. Let's program our Arduino

- we connect our sensors and actuators on the inputs and outputs of our arduino board;
- the Vittascience arduino interface is installed on the PC to access programming blocks;
- we connect our Arduino board to the PC;
- the program is done on the PC;
- the program is uploaded to the arduino board;
- we test our program on the card by intervening on the sensors.



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1. Environmental Projects Across Europe

Austria: Smart Irrigation Management

Concept: A system that waters plants only when they actually need it, based on soil moisture levels.

How it works:

Soil moisture sensors measure water content at different depths

Arduino processes this data to determine irrigation needs

System activates watering only when necessary and stops when soil is sufficiently moist

Environmental impact:

Up to 60% water savings compared to traditional irrigation

Reduced soil erosion and fertilizer runoff

Healthier plants with optimized water usage

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2. Environmental Projects Across Europe

Italy: Autonomous Smart Greenhouse

Concept: A self-regulating greenhouse that creates optimal growing conditions while minimizing resource use.

How it works:

Sensors monitor temperature, humidity, light levels, and water availability

Arduino automatically activates ventilation, irrigation, or lighting as needed

System adapts conditions based on plant type requirements

Environmental impact:

90% less water usage than traditional farming

Enables local food production year-round, reducing transportation emissions

Optimizes plant growth with minimal resources

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3. Environmental Projects Across Europe

Turkey: Intelligent Street Lighting

Concept: Street lights that automatically activate only when vehicles or pedestrians are present.

How it works:

Motion sensors detect approaching cars or pedestrians

Arduino turns on lights just ahead of movement

Lights dim gradually after passage

Environmental impact:

60-80% reduction in electricity usage

Decreased light pollution affecting nocturnal animals

Extended lifespan of lighting equipment

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4. Environmental Projects Across Europe

Croatia: Low-Cost Seismic Detection Network

Concept: An affordable earthquake early warning system that helps communities prepare for seismic events.

How it works:

Vibration sensors (accelerometers) detect early seismic waves

Arduino analyzes vibration patterns to identify earthquakes

System triggers alarms and sends alerts when needed

Climate change connection:

Climate change increases geological instability in some regions

Early warning systems are crucial for adaptation to extreme events

Prevents secondary disasters like fires or chemical spills

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5. Environmental Projects Across Europe

Poland: Eco-Friendly Airship Monitor

Concept: A solar-powered mini-airship equipped with sensors to monitor air quality and detect pollution.

How it works:

Arduino controls motors and propellers for movement

Sensors measure CO₂, particulate matter, and other pollutants

Camera captures images of monitored areas

Solar panels provide clean energy for operation

Environmental impact:

Maps air pollution patterns in different areas

Identifies pollution sources for targeted action

Zero-emission monitoring solution

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6. Environmental Projects Across Europe

Greece: Self-Regulating Climate-Adaptive Building

Concept: A system that automatically adapts a building to weather conditions by controlling windows, blinds, and ventilation.

How it works:

Sensors measure temperature, humidity, light, wind, and rain

Arduino decides when to open/close windows and blinds

System prioritizes natural solutions (ventilation, daylight) before mechanical systems

Environmental impact:

40-60% reduction in energy consumption

Decreased reliance on artificial air conditioning

Better adaptation to extreme weather events related to climate change

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7. Environmental Projects Across Europe

France: Smart Thermal Regulation System

Concept: A system that automatically optimizes heating and cooling based on indoor and outdoor temperature sensors.

How it works:

Temperature sensors measure conditions in different areas

Arduino compares these readings and controls heating/cooling systems

Energy is used only when truly necessary

Environmental impact:

15-30% reduction in energy consumption

Lower CO₂ emissions from heating and cooling

Prevents energy waste through precise regulation

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Why are these projects important?

They show how technology can help:

- **Saving resources:** water, energy, materials
- **Reduce** our environmental impact
- **Adapting** to climate change already underway
- **Educate others** about the importance of taking action
- **Create** local solutions to global problems

Above all, they prove that:

- **You don't need** to be an expert to get started
- **Every small project counts** in the fight against climate change
- **Young people have a crucial role** to play in green innovation
- **International collaboration** (such as Erasmus) to share best ideas

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Conclusion

Arduino represents an accessible entry point to ecological innovation for students of all backgrounds. The projects showcased demonstrate how relatively simple technology can address complex environmental challenges.

Each country has brought its unique perspective to solving environmental problems using the same basic technology. **This perfectly embodies the Erasmus spirit: sharing cultures and ideas to create a better future together.**

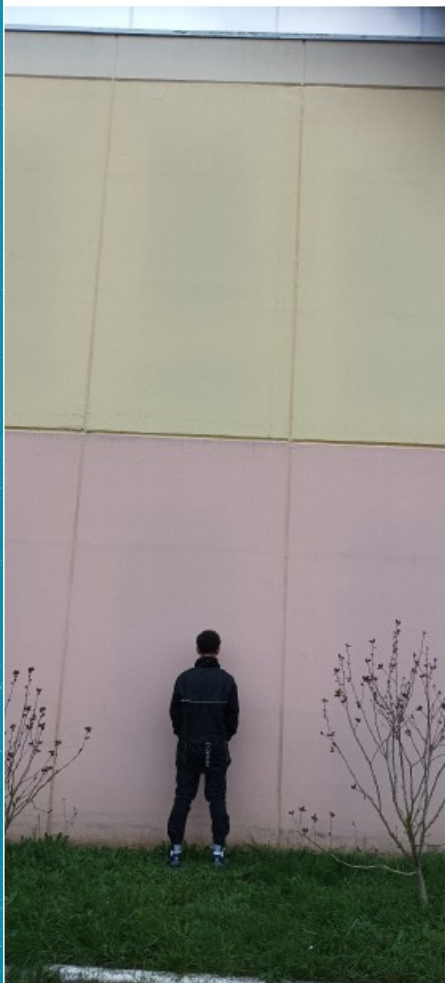
These Arduino-based solutions prove that fighting climate change doesn't always require complex, expensive technology. Sometimes, the most powerful innovations come from accessible tools in the hands of creative young minds.

By combining these approaches, an integrated and coherent strategy can emerge, where each solution contributes to the collective effort of reducing our environmental footprint while preparing our societies to adapt to the already inevitable consequences of climate change.

Our students from the robotics club during a departmental competition



Deduce the dimensions of our school



Creation of the model with the SketchUp

