LabsLand

FOR FOR HIGHER EDUCATION

DECEMBER 2022

Real labs online

LABSLAND

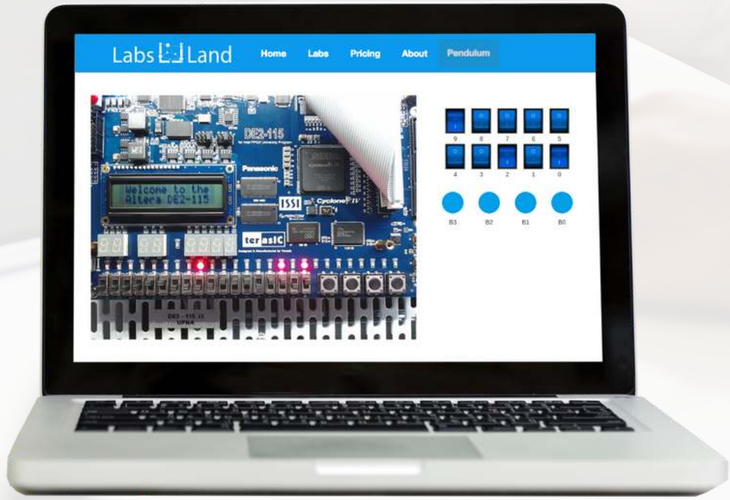
Visualise and interact with real devices

Use it from anywhere at any time

The equipment are real, not simulated. They are in LabsLand or in partner institutions.

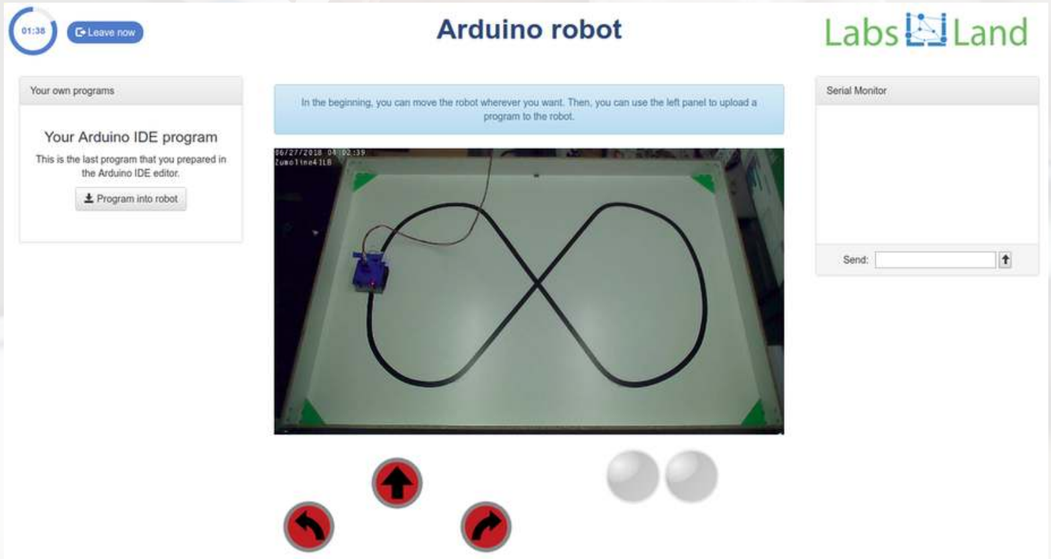
LabsLand provides access to real laboratories and educational equipment, but online. With just a browser, students can access and control them.

LabsLand labs are generally developed with our own technology but in collaboration with universities. With this approach we ensure that the labs are adapted to the teaching needs and the educational institutions also gain several advantages.



OUR PRODUCT: AN EXAMPLE

Lab example: Arduino Robotics: Students write code and observe how it works on a real robot and interact with it.



Access to laboratories

LabsLand is the world's largest remote laboratory platform. We are experts in remote laboratory technology. Our main service is to provide access to our remote laboratory network. Most institutions buy LabsLand subscriptions to access laboratories from the LabsLand network. If that is your case, you may check our catalogue of laboratories in the labs section.

Purchase of remote lab equipment

In LabsLand we have designed many remote laboratories that have been successfully deployed not only in our premises but in institutions around the world. Many of those are powering our network of remote laboratories.

Real-time remote lab development

Real-time laboratories make it possible to control real equipment, online. Using only a web browser, users can see and interact with the equipment. There can be remote laboratories for many fields, such as robotics, electronics, embedded systems or physics.

Ultraconcurrent lab development

Ultraconcurrent laboratories are based on a set of pre-recorded experiences carried out at a real lab. LabsLand can build ultraconcurrent labs for Physics, Chemestry, Biology, Instrumentation and mch more.

LABS, EQUIPMENT AND SERVICES

1. Access to Laboratories

1- Digital electronics
- FPGA
- Intel DE2-115
- Intel DE1-SoC
- Digital Trainer
- Boole Designer
- STM32 Nucleo
- ATmega328p
- TI TIVA TM4C129EXL

2- Robotics & Tech
- Arduino Robot
- Basic Arduino
- 3D Printer

3- General electronics
- Electronics
- AC Electronics
- Common circuits

4- Physics
- Kinematics
- Radioactivity
- Archimedes
- Pendulum
- Spring
- Advanced buoyancy
- Optics
- Boyle's Law
- Electronics
- AC Electronics
- Snell's Law
- Conservation of Momentum
- Free Fall

5- Engineering & Instrumentation
- Luxometer
- Sonometer
- Thermographic Camera
- Centrifugal Pump
- Pelton Turbine
- Texture Analyser
- Flowloop

6- Chemistry
- Gay-Lussac's Law
- Boyle's Law
- Acid-Base titration (v1)
- Acid-Base titration (v2)
- Diffusion
- Exchangeable Acidity of Soils
- Water Heating and Cooling Curves

7- Biology
- Planarians

2. Remote Laboratory Hardware

- Arduino Robot
- Arduino Board
- Intel DE1-SoC
- Intel DE2-115
- ST Nucleo WB55RG
- TIVA Launchpad with tm4c129
- Analog Electronics lab

3. Additional Services

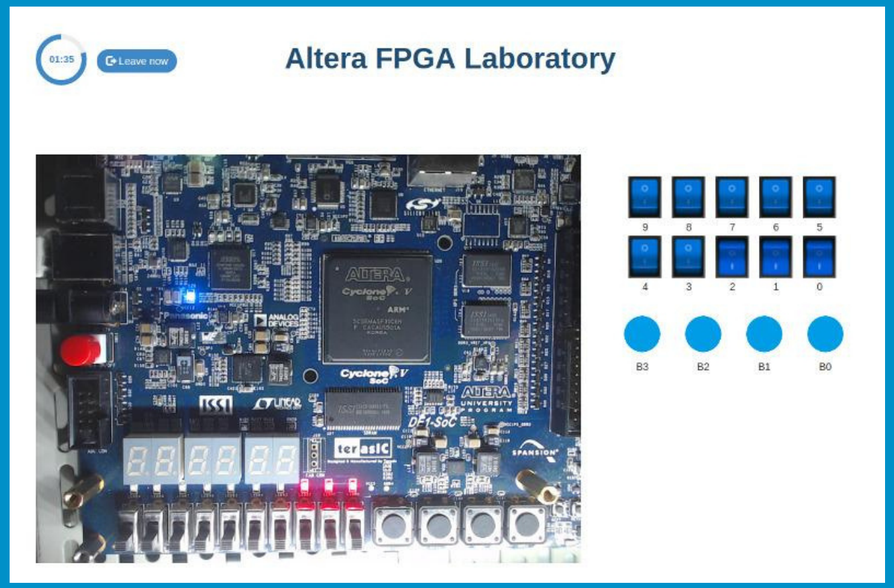
- Creation of real-time labs
- Creation of ultraconcurrent labs

1. Access to Laboratories

Digital Electronics Laboratories

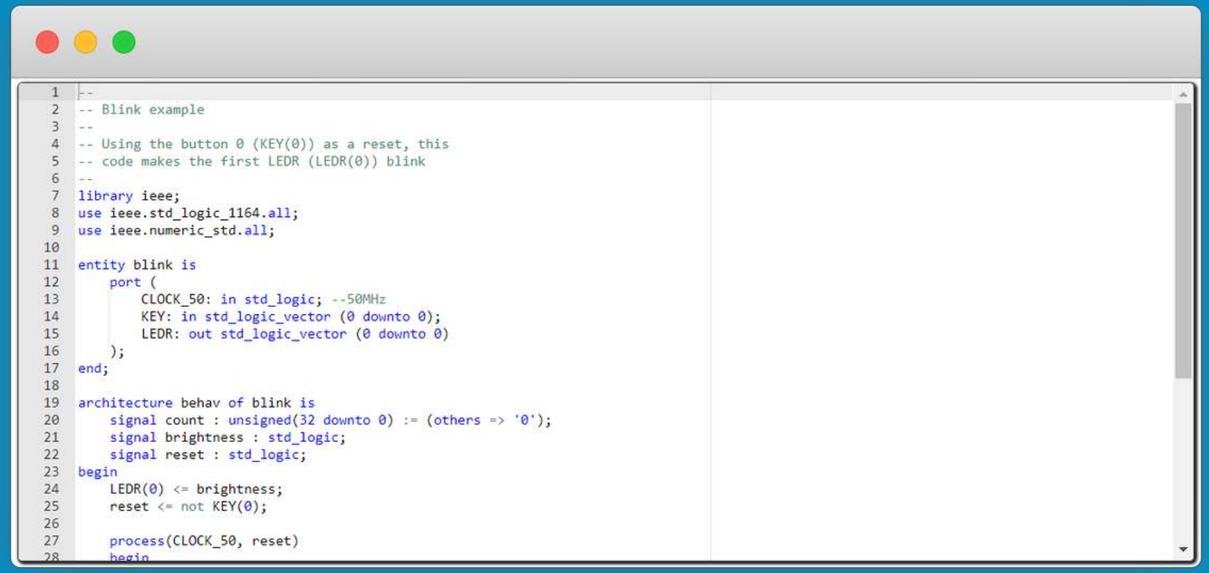
FPGA

- Learn how to use FPGAs using VHDL or Verilog, and test your code on one of our many available boards. In this lab each board supports a set of basic peripherals: 10 LEDs, 6 7-segment displays and multiple clocks. It also supports 10 controllable switches and 4 buttons that you can use in your design.
- Every time you synthesise your code you can test it on a real board and interact with it to see how it behaves.
- Generic FPGA Lab: Intel boards of different models will be assigned, but with code that is always compatible. If a specific model is needed, alternative versions of the lab can be used.



Intel DE2-115

- It uses real Terasic DE2-115 FPGA boards via VHDL or Verilog.
- The FPGA supports various peripherals: 18 red LEDs, 9 green LEDs, 8 7-segment displays, multiple clocks. In addition, you have access to 18 switches and 4 buttons that you can use in your design.
- Versions of this lab are available with support for additional features, such as NIOS II system or VGA output.
- Interaction with the boards in real time and via video streaming.



```
--
-- Blink example
--
-- Using the button 0 (KEY(0)) as a reset, this
-- code makes the first LEDR (LEDR(0)) blink
--
library ieee;
use ieee.std_logic_1164.all;
use ieee.numeric_std.all;

entity blink is
    port (
        CLOCK_50: in std_logic; --50MHz
        KEY: in std_logic_vector (0 downto 0);
        LEDR: out std_logic_vector (0 downto 0)
    );
end;

architecture behav of blink is
    signal count : unsigned(32 downto 0) := (others => '0');
    signal brightness : std_logic;
    signal reset : std_logic;
begin
    LEDR(0) <= brightness;
    reset <= not KEY(0);

    process(CLOCK_50, reset)
    begin
```

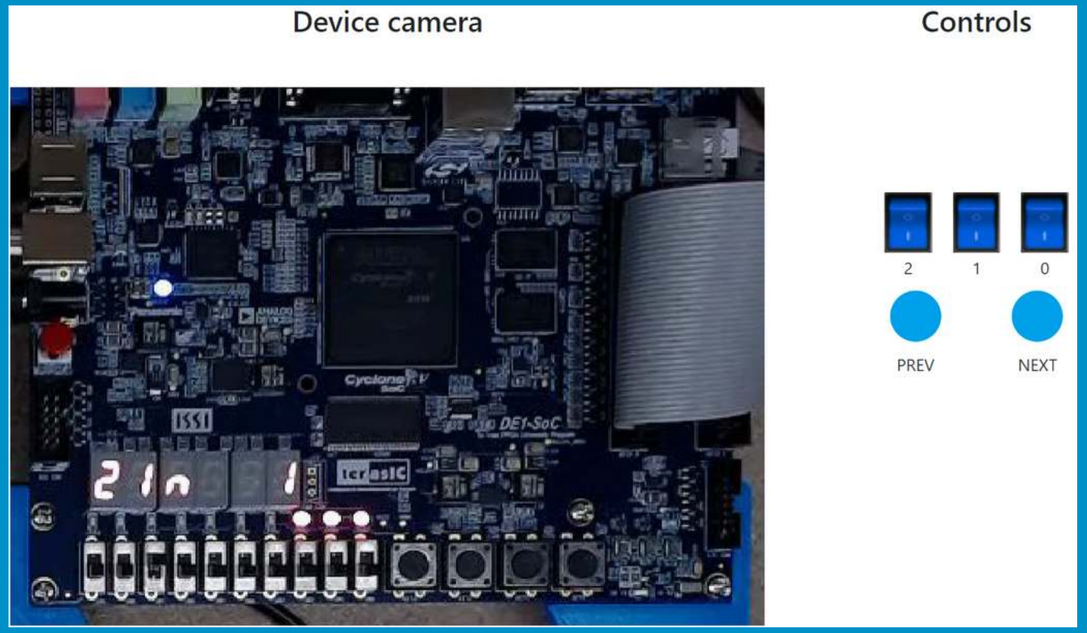
Intel DE1-SoC

- It uses real Terasic DE1-SoC FPGA boards via VHDL or Verilog.
- The FPGA supports various peripherals: 10 red LEDs, 6 7-segment displays or multiple clocks. In addition, you have access to 10 switches and 4 buttons that you can use in your design.
- Interaction with the boards in real time and via video streaming.

```
1  //
2  // Mirror sample code
3  //
4  // This code takes the switches 0 to 9 (SW)
5  // and turns on the corresponding LEDs (LEDR). It also
6  // takes the buttons (KEY) and if you click on each
7  // button, it will show the corresponding button number
8  // in the 7-segment display (HEX0).
9  //
10 module leds_mirror(SW, KEY, LEDR, HEX0);
11
12 input [0:9] SW;
13 input [3:0] KEY;
14 output [0:9] LEDR;
15 output [0:6] HEX0;
16
17 reg  [0:9] LEDR;
18 reg  [0:6] HEX0;
19
20
21 always @ (*)
22
23 begin
24     LEDR <= SW;
25     case( KEY )
26         4'B1110: HEX0 = 7'B0000001;
27         4'B1101: HEX0 = 7'B1001111;
28         4'B1011: HEX0 = 7'B0010010;
```

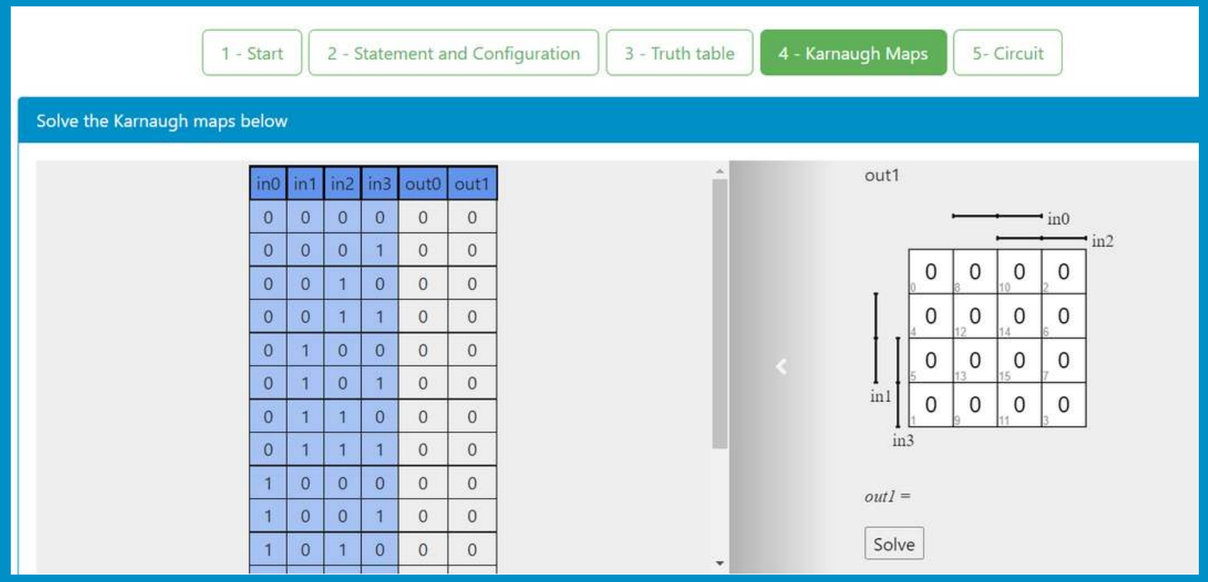
Digital Trainer

- The Digital Trainer laboratory is designed towards students that are starting with digital logic, truth tables and Boole's Algebra.
- During the activity, the student sees an Intel FPGA that implements a series of simple truth tables. The student can interact with the FPGA devices to vary the inputs to the system through switches, and observe the outputs through LEDs. The challenge is to determine which logical operator the FPGA implements in each case (e.g. AND, NAND...).



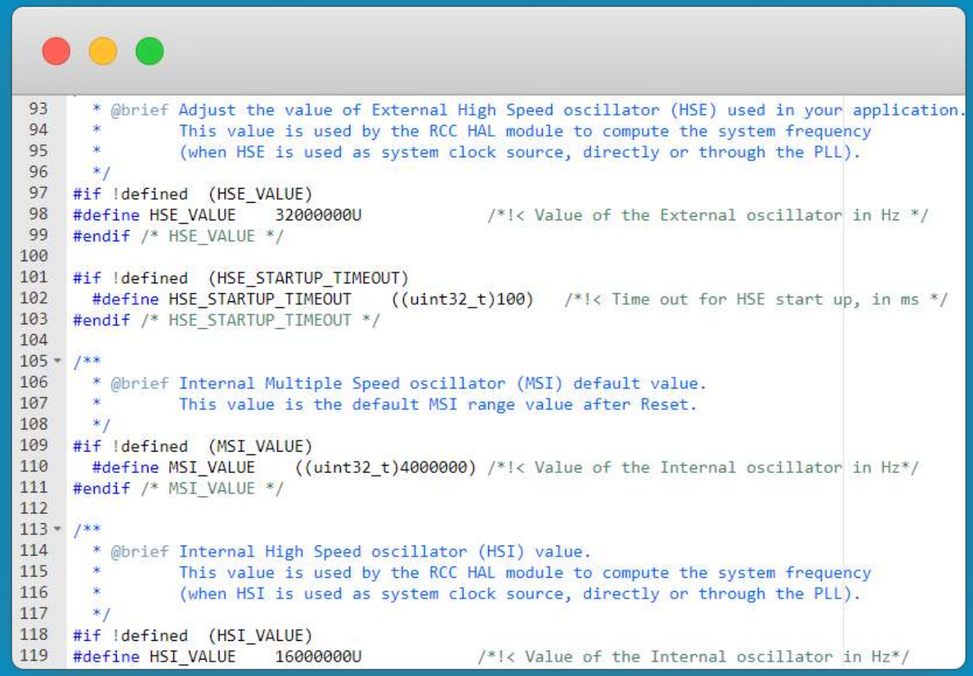
Boole Designer

- This laboratory will let you learn basic Digital Electronics.
- You will be able to design Combinational Systems by designing and filling a truth table, use Boolean Algebra, create Karnaugh–Veitch (KV or VK) maps, and try the systems that you create in real remote hardware (Intel FPGAs).



STM32 Nucleo

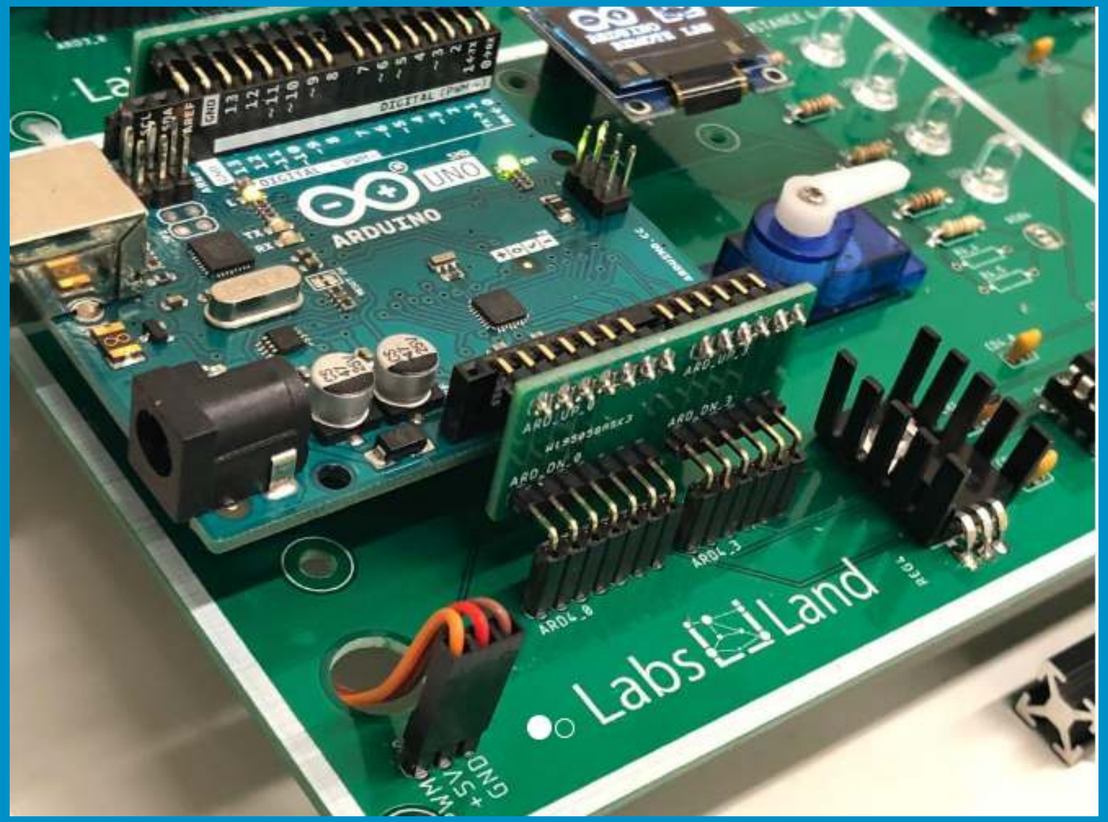
- With this lab, you can program a real ARM microcontroller with the NUCLEO-WB55RG development board from the manufacturer STMicroelectronics. It includes various input and output peripherals, typical of IoT applications. It is also possible to program the board with various low-power types, very useful for IoT devices.



```
93   * @brief Adjust the value of External High Speed oscillator (HSE) used in your application.
94   *        This value is used by the RCC HAL module to compute the system frequency
95   *        (when HSE is used as system clock source, directly or through the PLL).
96   */
97  #if !defined  (HSE_VALUE)
98  #define HSE_VALUE    32000000U            /*!< Value of the External oscillator in Hz */
99  #endif /* HSE_VALUE */
100
101 #if !defined  (HSE_STARTUP_TIMEOUT)
102   #define HSE_STARTUP_TIMEOUT    ((uint32_t)100)   /*!< Time out for HSE start up, in ms */
103 #endif /* HSE_STARTUP_TIMEOUT */
104
105 /**
106   * @brief Internal Multiple Speed oscillator (MSI) default value.
107   *        This value is the default MSI range value after Reset.
108   */
109 #if !defined  (MSI_VALUE)
110   #define MSI_VALUE    ((uint32_t)4000000) /*!< Value of the Internal oscillator in Hz*/
111 #endif /* MSI_VALUE */
112
113 /**
114   * @brief Internal High Speed oscillator (HSI) value.
115   *        This value is used by the RCC HAL module to compute the system frequency
116   *        (when HSI is used as system clock source, directly or through the PLL).
117   */
118 #if !defined  (HSI_VALUE)
119 #define HSI_VALUE    16000000U            /*!< Value of the Internal oscillator in Hz*/
```

ATmega328p

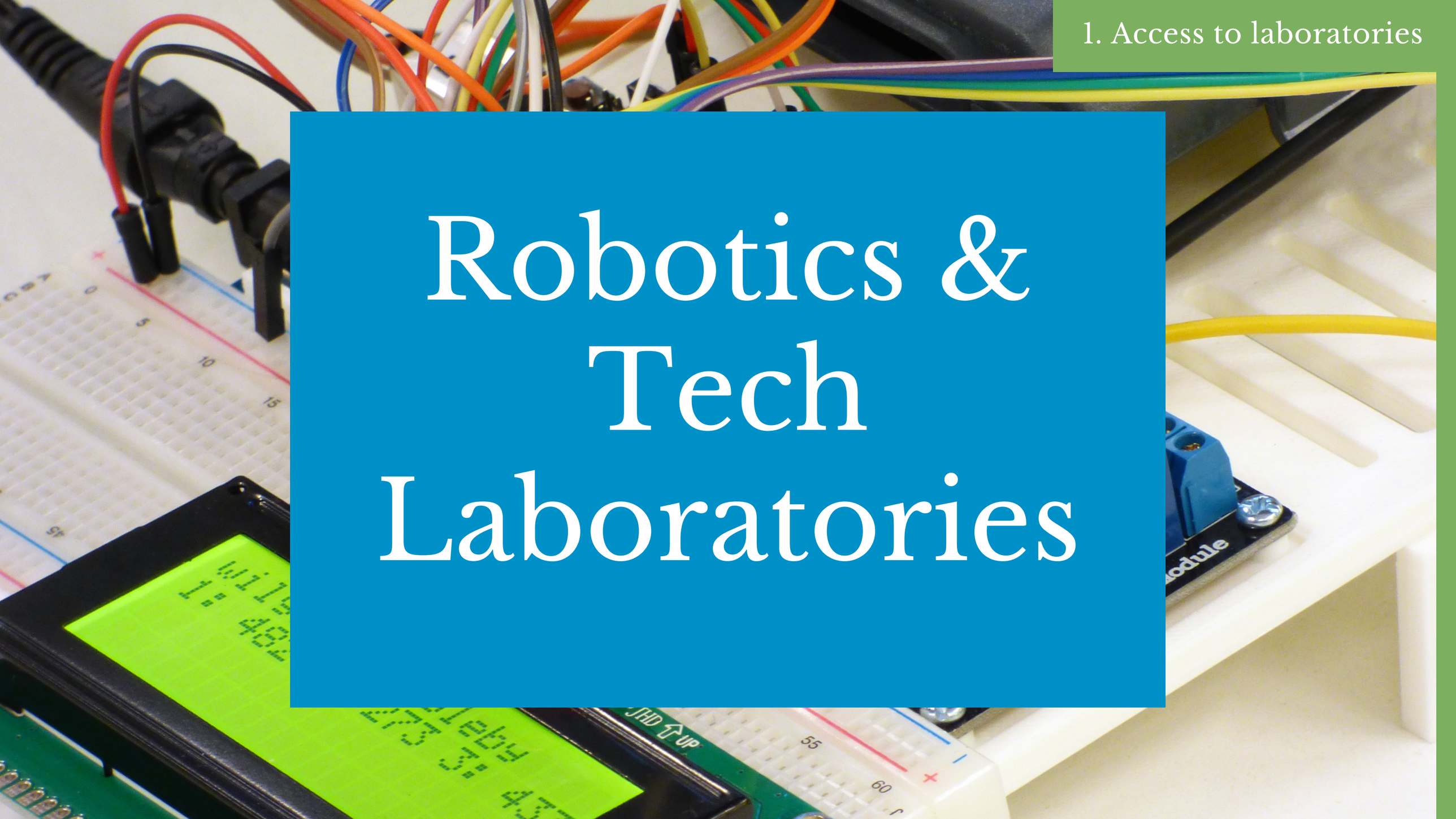
- Use an online IDE to program ATMEL's ATmega328p microncontroller using assembly language. The ATmega328p is used in the Arduino UNO, which is in fact the board that you will be able to program. Various peripherals are attached, including LEDs, potentiometers and a servo motor, among others.



TI TIVA TM4C129EXL

- With this laboratory you can program and control a Texas Instruments TIVA C Series TM4C129EXL board. It also includes various input and output peripherals, similar to those that are often used in embedded systems and microcontroller programming courses.

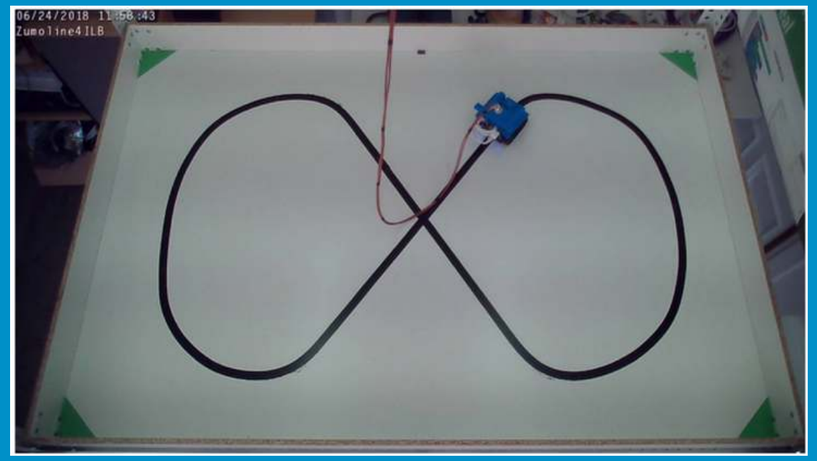
Coming soon



Robotics & Tech Laboratories

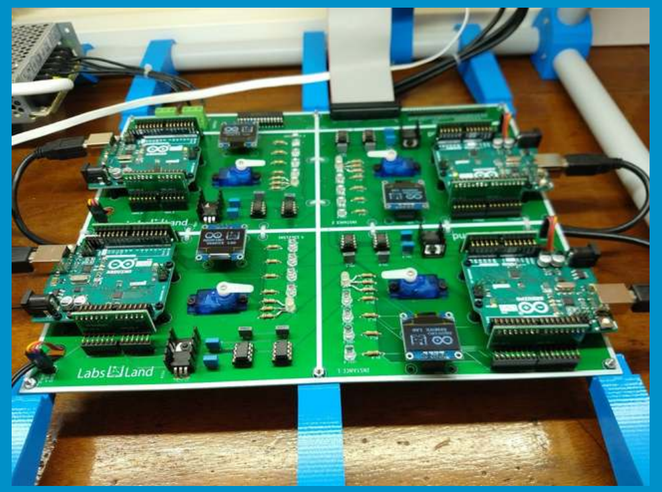
Arduino Robot

- The Arduino-based robotics lab allows you to develop multiple experiments with a real mobile robot.
- Programming available in visual language or code.
- Download your program directly on the robot to see through a camera its behaviour.
- You can avoid obstacles, compete in race tracks, find the exit of a labyrinth and even fight against another robot in the near future.



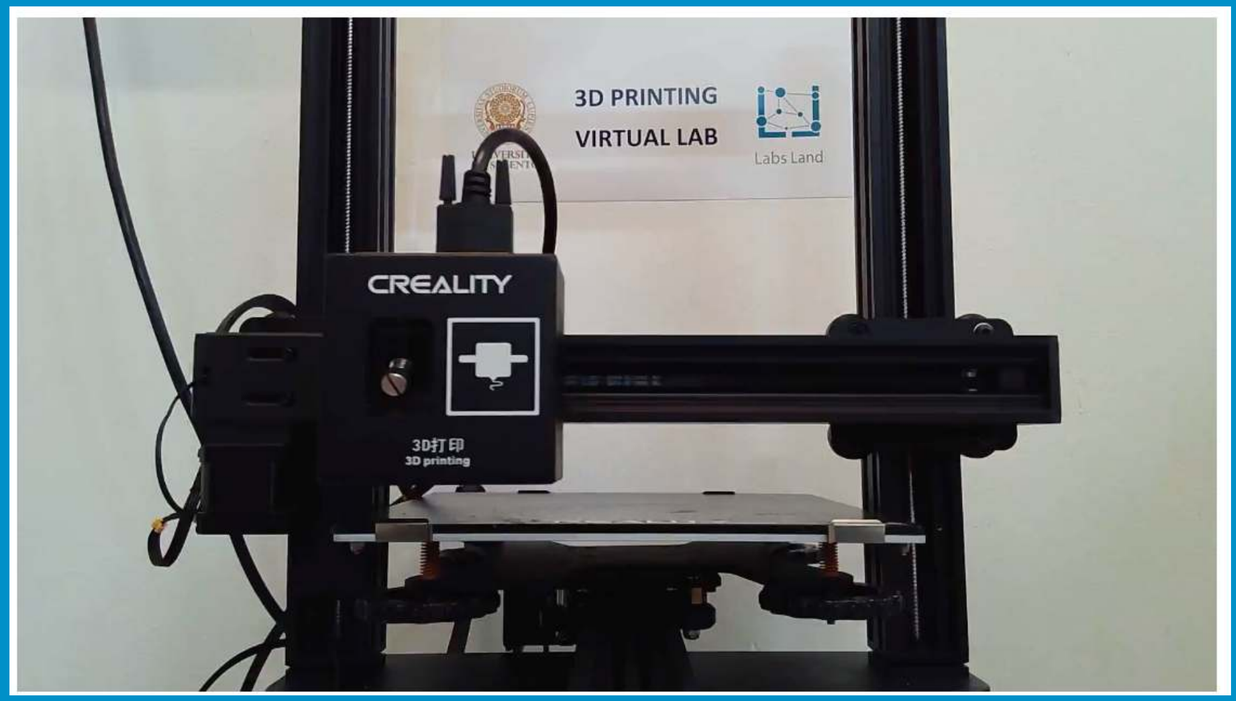
Basic Arduino

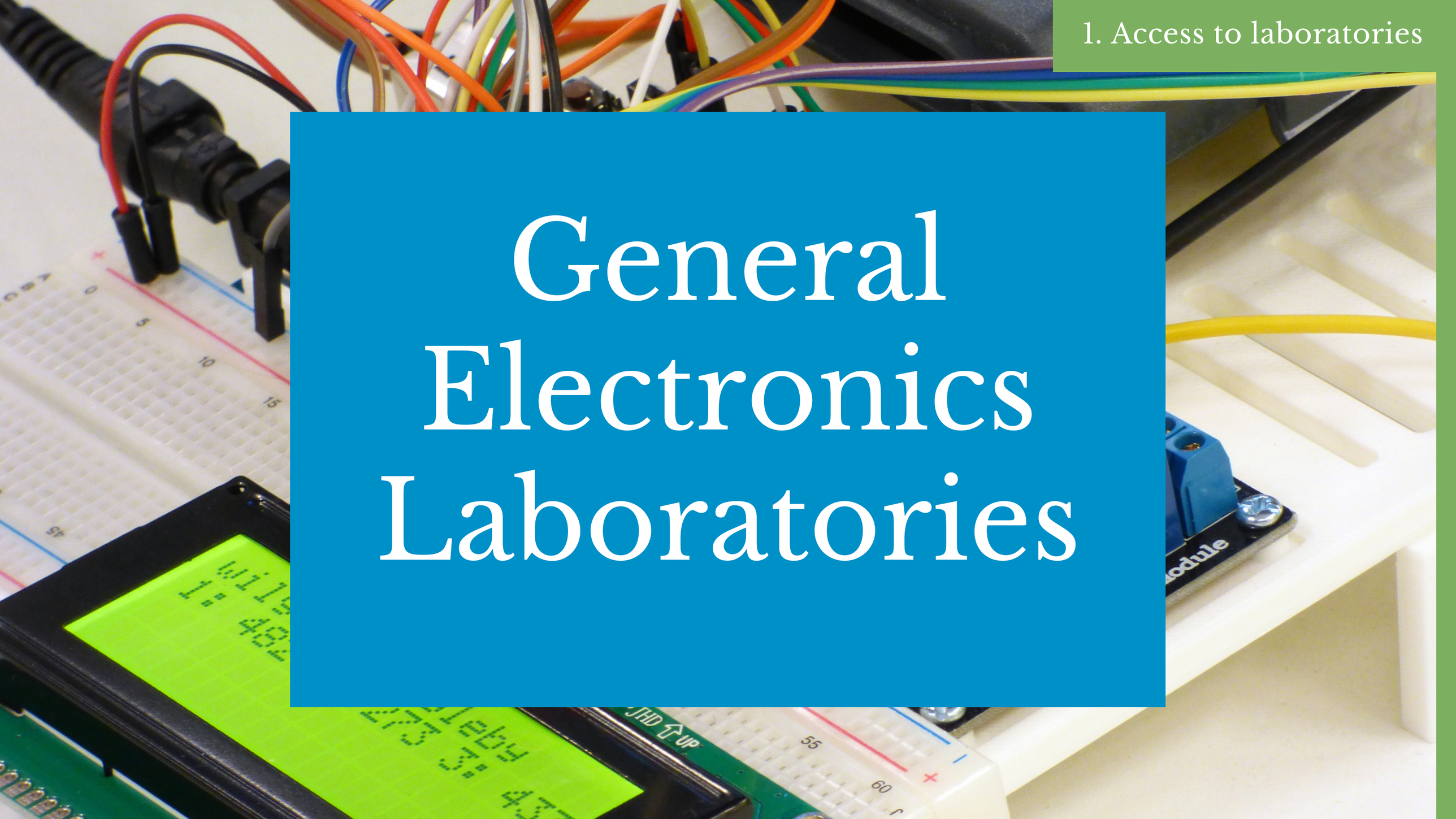
- With this lab you can program a real Arduino Uno board through a visual language or a traditional code-based language.
- It also includes several input and output peripherals, similar to those included with typical Arduino starter kits.
- What do these peripherals include?
  - LEDs.
  - Switches.
  - A small OLED display.
  - A servo motor and others.



3D Printer

- This lab allows you to choose between different 3D printing settings.
- You can observe the printing process and the result from different angles.
- In addition, you can also control the playbk speed.
- Finally, you have the option to download the Ultimaker Cura project file for further experimentation.

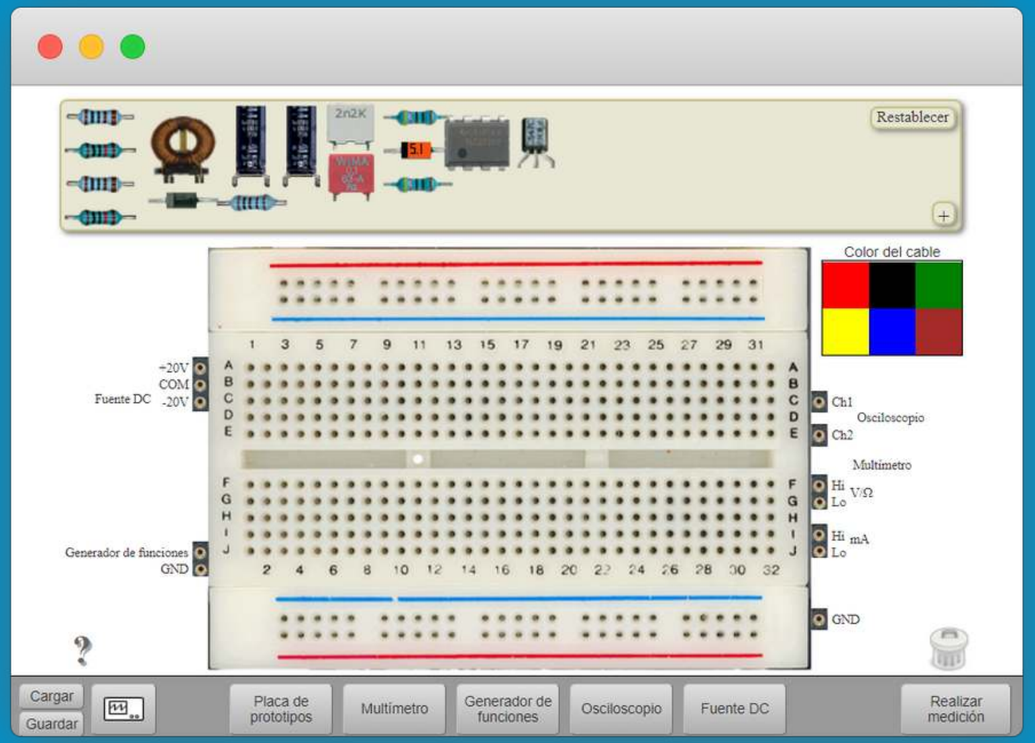


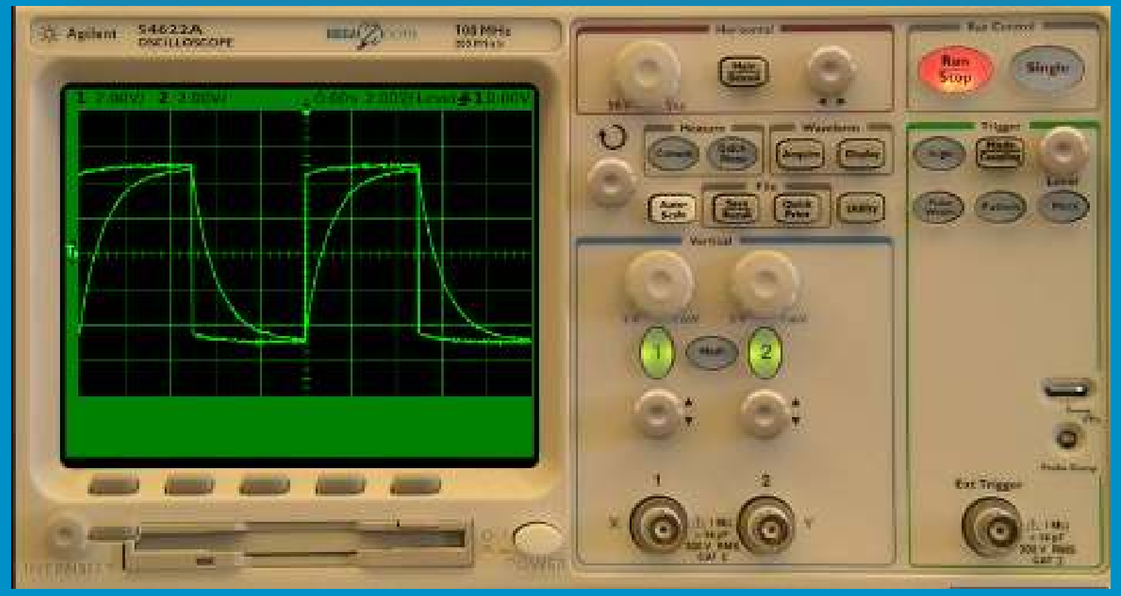


General Electronics Laboratories

Electronics

- Remote laboratory for experimenting with the laws and principles that govern the operation of analogue electronics: association of resistors, Ohm's Law, Kirchhoff, transmission of maximum power, characterisation of components, etc.
- In this laboratory you will be able to create real electronic circuits using typical components: resistors, capacitors, coils, diodes, etc. and check their operation using real instruments such as a function generator, oscilloscope, power supply or multimeter.
- To do this, you will have at your disposal a very advanced graphic interface that will allow you to carry out the same operations over the Internet as if you were in a traditional laboratory.

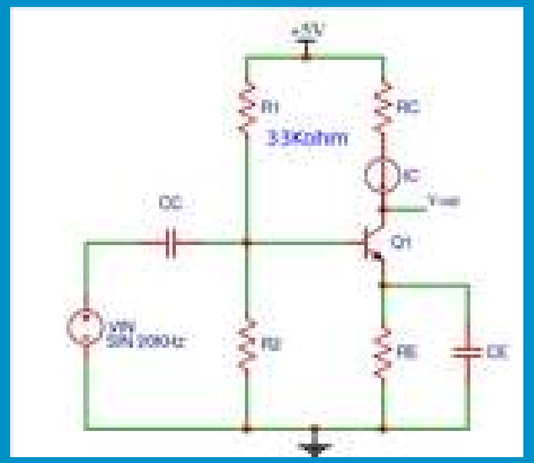


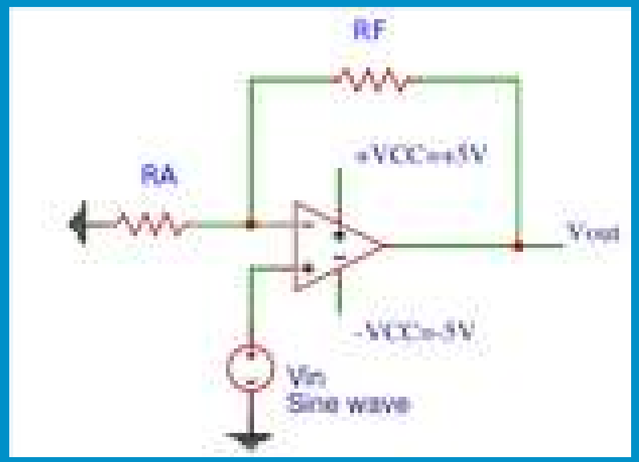


Common Circuits

Set up different circuits and then analyse them. The different circuits are the following:

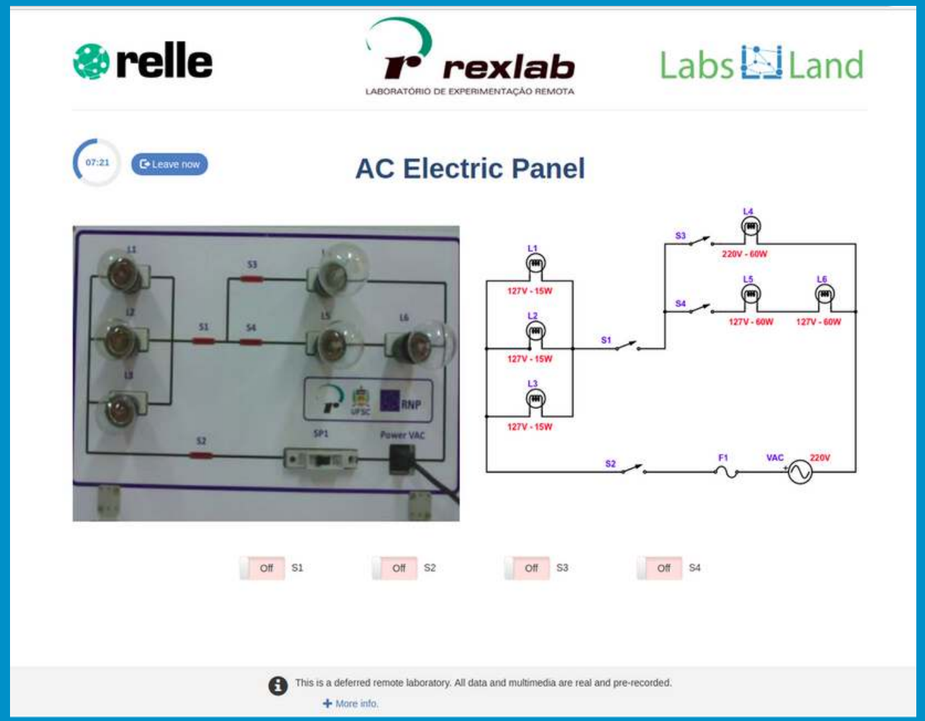
- Collector Amplifier
- High Pass Filter
- Low Pass Filter
- Emitter Amplifier
- Operational Amplifier
- Astable Multivibrator with 555 Timer

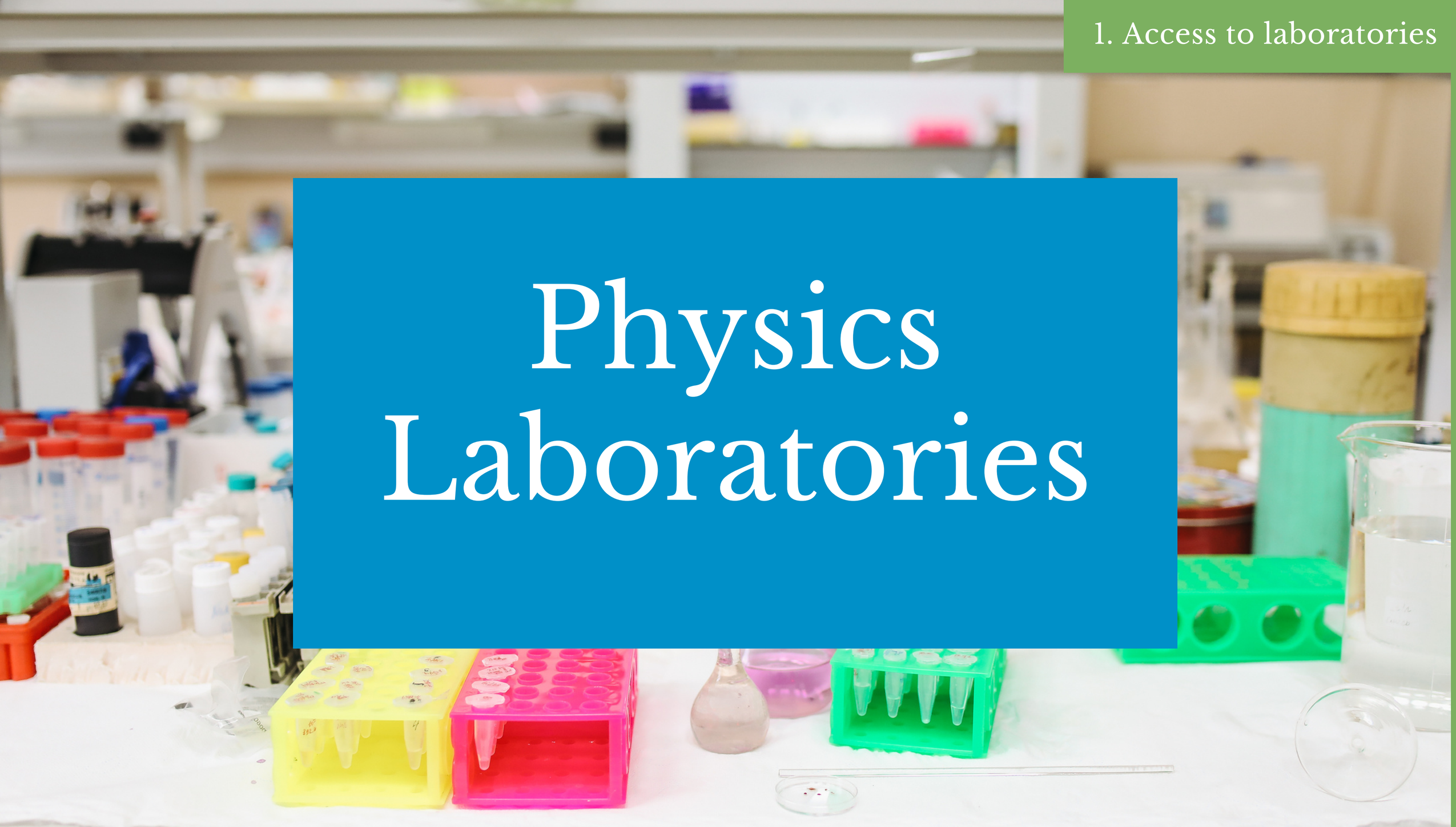




AC Electronics

- Study how AC alternating current (Alternating Current) works by experimenting with several light bulbs connected in series and/or parallel.
- By opening or closing the switches of your choice, you can see the effect on the light intensity of each of the bulbs in the circuit that is created.

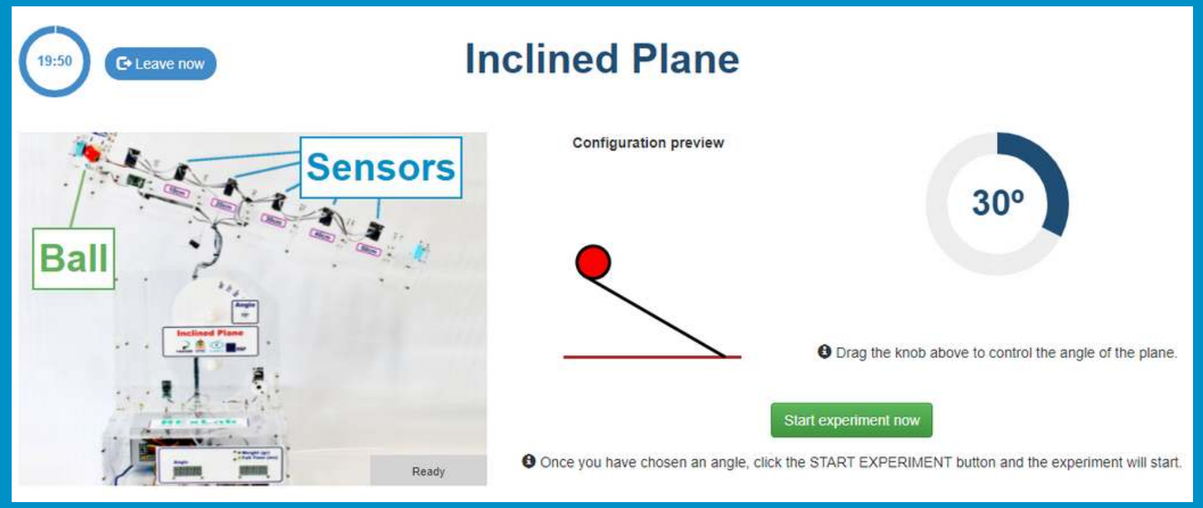




Physics Laboratories

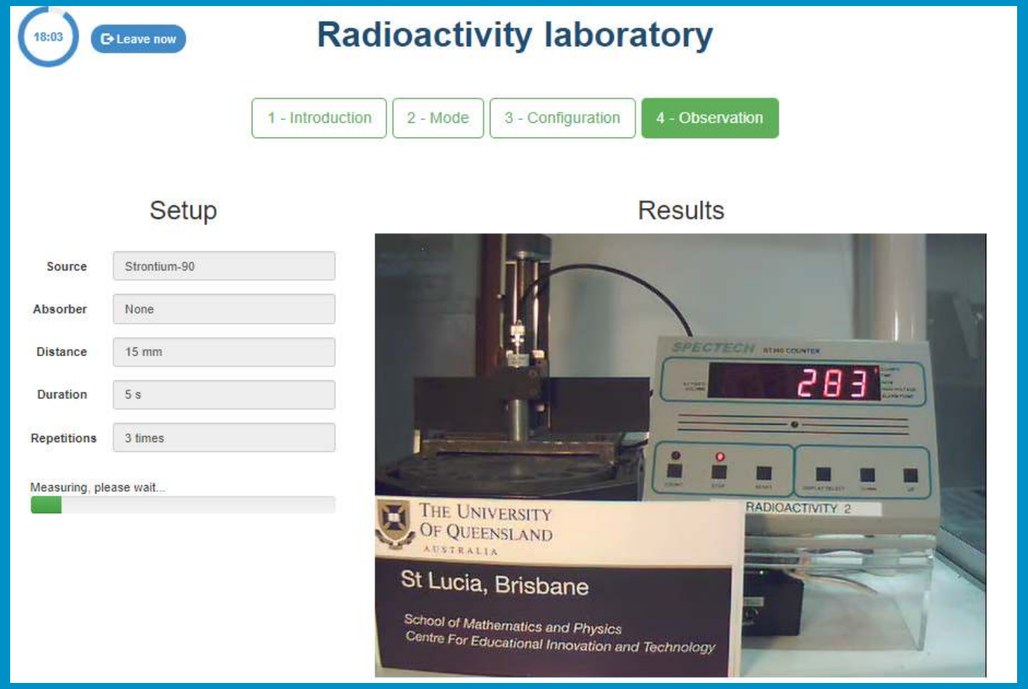
Kinematics

- You will be able to experiment with Newton's second law in a system that allows you to observe and analyse the behaviour of a ball moving along an inclined plane or in a free fall.
- The parameters to be analysed are: time, velocity and acceleration of the ball during the fall.
- The angle of inclination is configurable by the user, reaching up to 90º and allowing students to experience a free fall scenario.



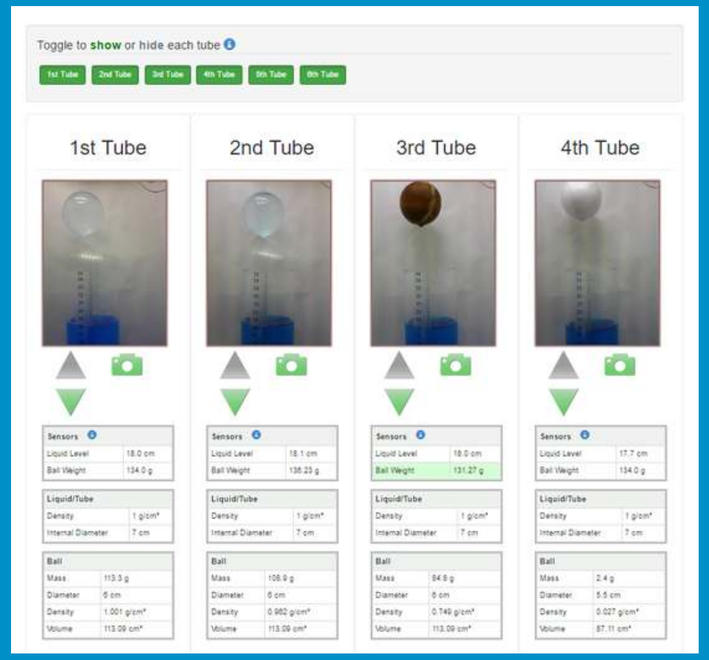
Radioactivity

- Tests the amount of particles emitted by different radioactive materials and captured by a real Geiger counter.
- Modify the distance between the sample and the counter, as well as the exposure time.
- You can also put an absorbent material between the sample and the counter and see what effect it has on the measurements.



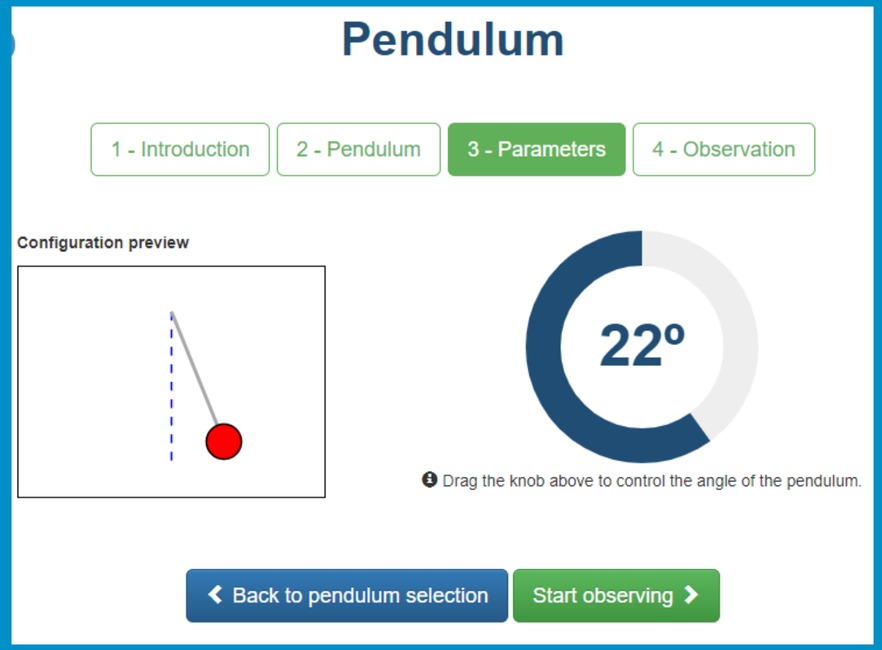
Archimedes

- Test with Archimedes' principle: raise and lower balls of different materials, sizes and weights and see what happens when they are placed in a liquid.
- Does it sink, does it float, why, can you determine its weight, what about the volume of the liquid dislodged, the thrust force?
- Try to answer all these questions by observing the experiment and using the values given by the available sensors.



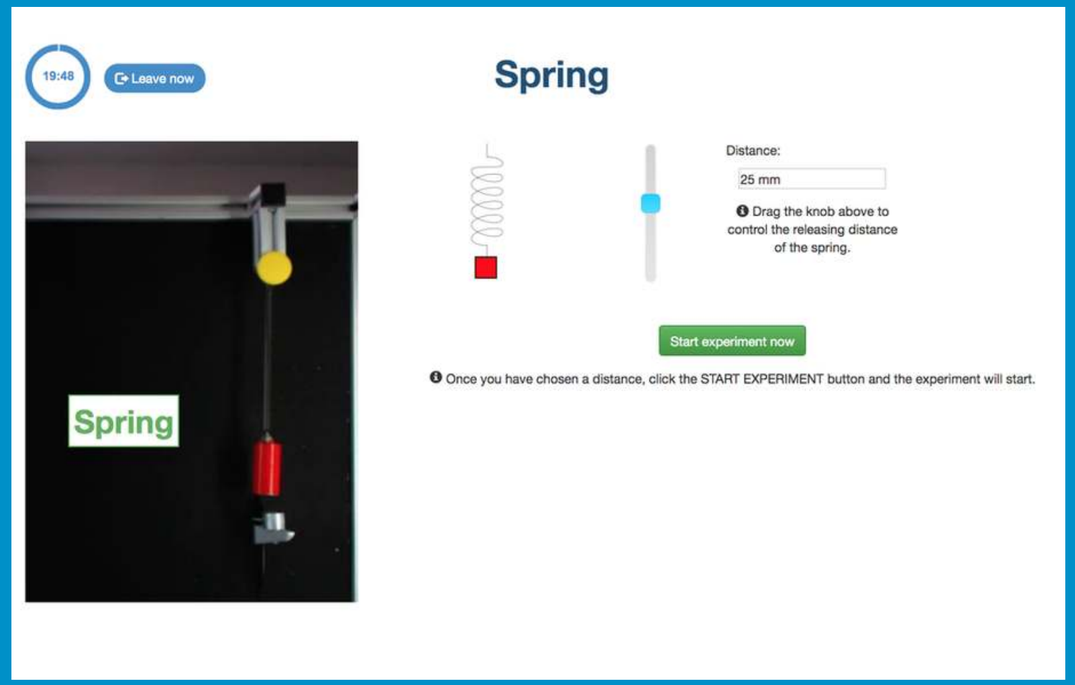
Pendulum

- With this experiment you can control the angle from which to release a real simple pendulum.
- The experiment will return a set of real data from which you can analyse the behaviour of the pendulum based on oscillation time, velocity, length of the oscillations, etc.
- You can also add weights to the pendulum.



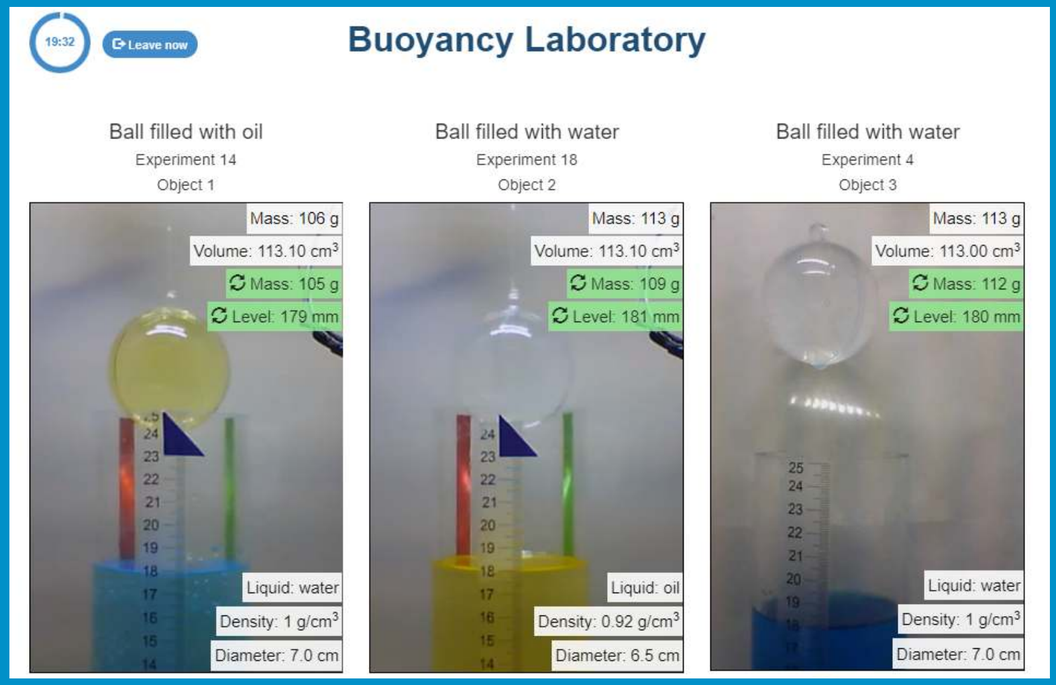
Spring

- With this lab, you can control the distance at which you move a spring, and see and measure its behaviour once it is released.
- This experiment will provide a set of real data, which can be used to analyse the behaviour of the spring depending on distance, time and other variables.



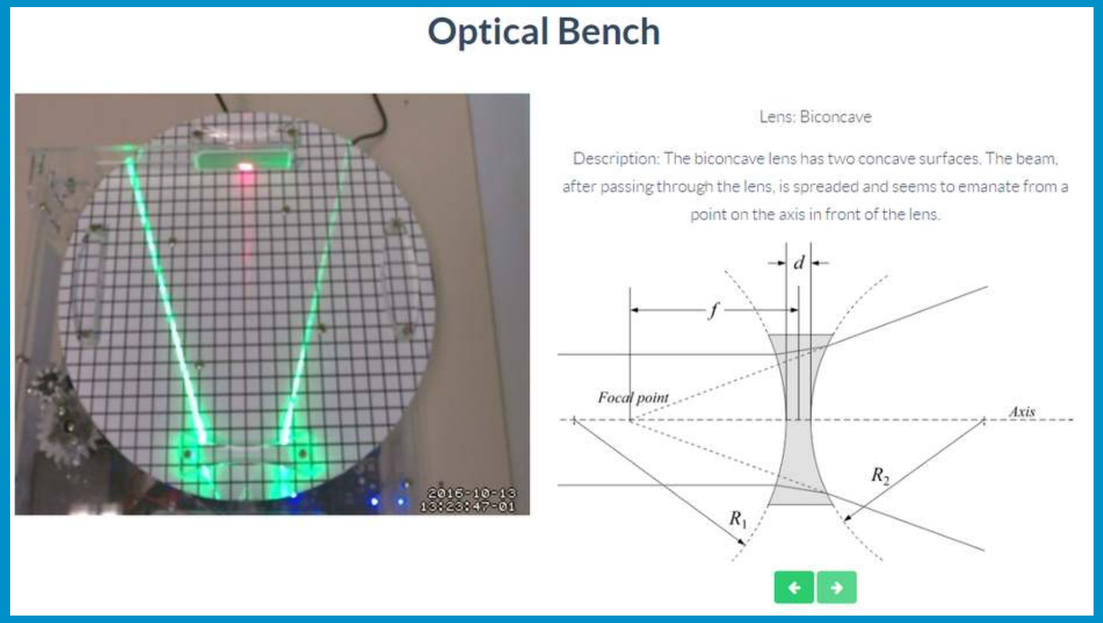
Advanced buoyancy

- Experiments related to buoyancy, Archimedes' Principle, and similar physical laws.
- He takes related measurements, conducts experiments, and begins to perform relatively advanced calculations and draw conclusions from them.
- All this in an advanced way.



Optics

- This remote laboratory allows you to observe what happens when two light rays pass through a biconvex, biconcave or convex lens. You will be able to control the lens to be analysed at any time.



Boyle's Law

View in Chemistry section.

Electronics

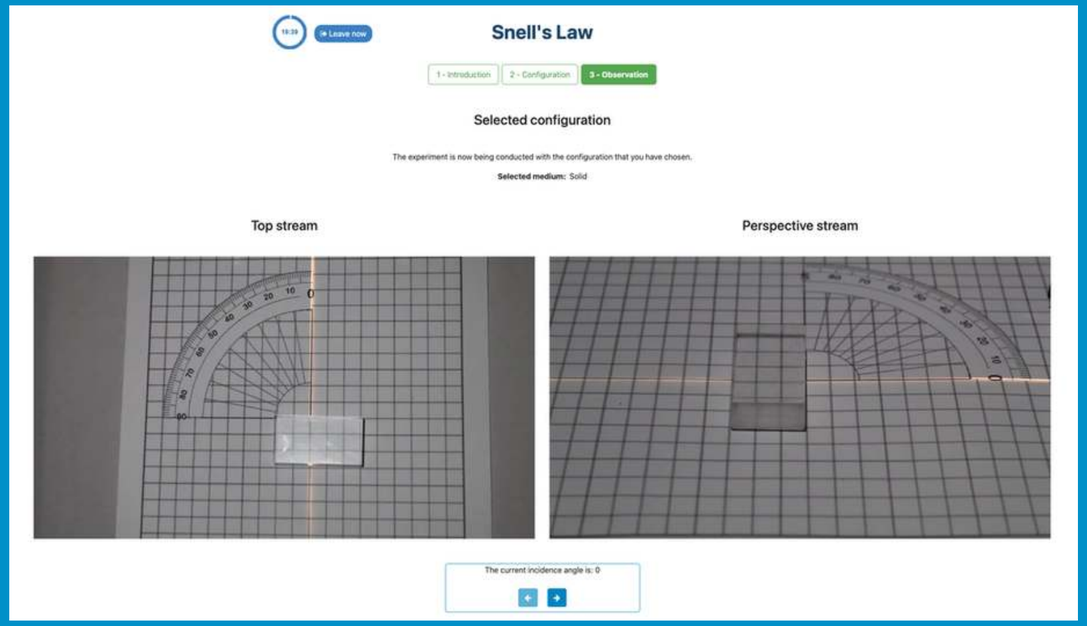
View in General Electronic section.

AC Electronics

View in General Electronic section.

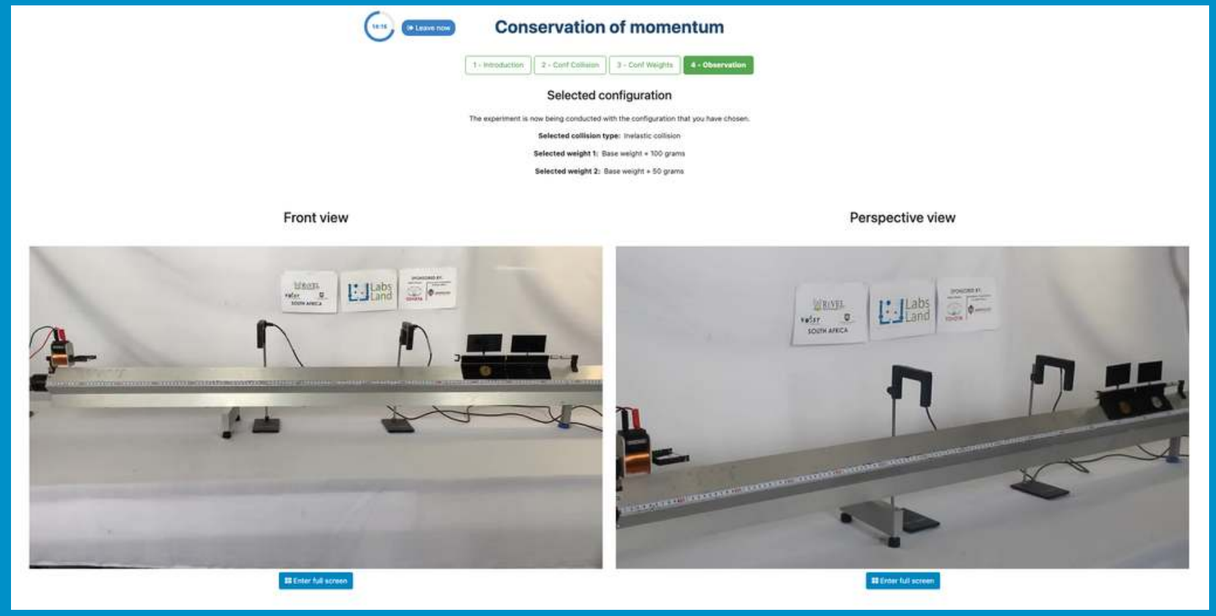
Snell's Law

- It's also known as the Law of Refraction.
- This lab allows you to study the relationship between angles of incidence and angles of refraction.
- You will be able to experiment with two different types of lenses (a solid lens or a water-filled lens) to determine their refractive indices.



Conservation of Momentum

- Through this laboratory you will be able to make two cars collide in an elastic or inelastic collision, and also varying certain experimental variables, such as the mass of the cars (from 50 g to 150 g).
- You can then experimentally test whether or not the total momentum changes after the collision.

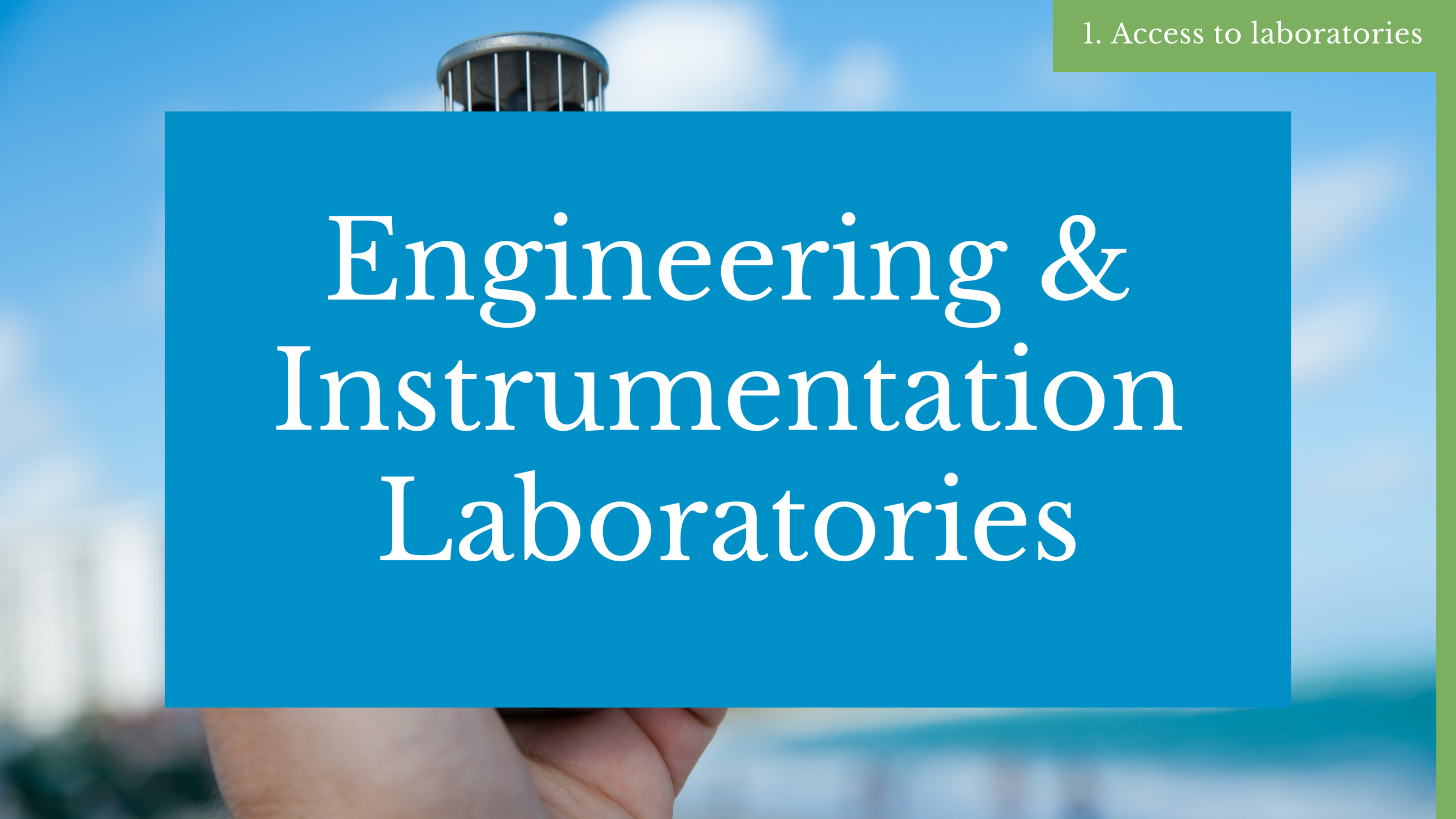


Free Fall

- Objects that free-fall are those that are influenced only by gravity's acceleration, what results in the kinematic equations for that movement.
- In this laboratory you will be able to experiment with different balls that will be subject to free fall. You can vary the height of each of them through an electric system that holds the ball magnetically; and later, through a switch, it is possible to active the fall of the ball down to a receiver that will register how much time it took to fall.
- With this, users will be able to experimentally calculate gravity, or alternatively, to conduct other types of experiments such as energy conservation for a free-falling object.

Front view

Screen view



Engineering & Instrumentation Laboratories

Luxometer

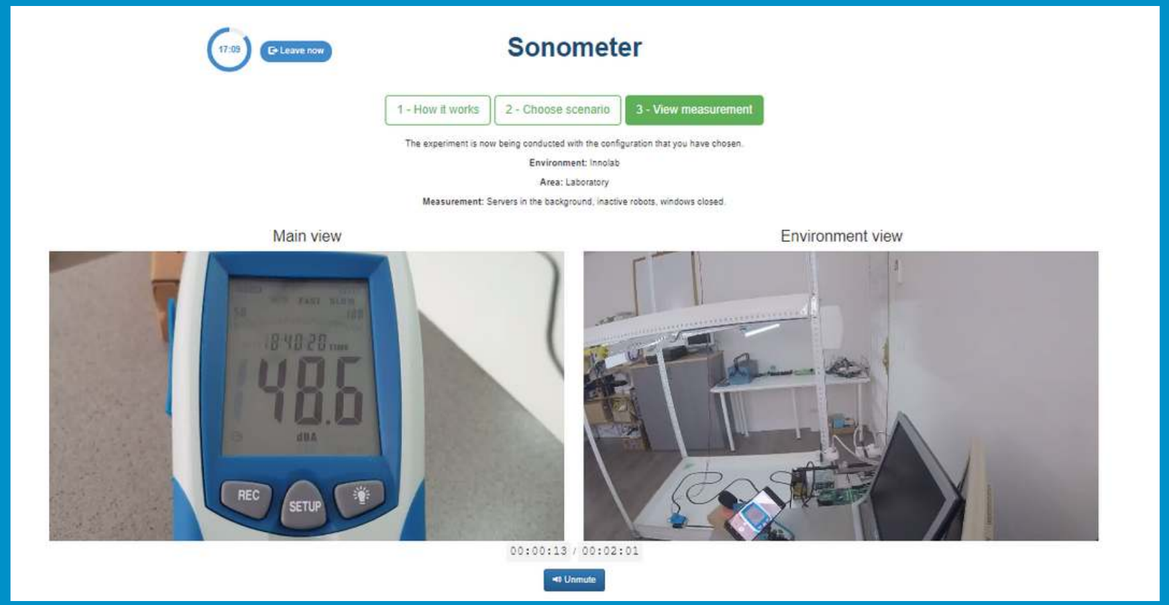
This device allows you to obtain real-time values of the lighting conditions of a built and operational space, and to be able to propose different alternatives thanks to its results.

Thermographic Camera

- It helps you to obtain real-time readings of surface temperature conditions, as well as to detect construction or operational incidents in the installations of a space.
- Discover the measurements made with a thermographic equipment model HTI HANDHELD 35200.
- This compact equipment offers a great deal of versatility when it comes to taking measurements on surfaces, and to instantly know the thermal conditions of a built element, a window, a piece of equipment, etc.

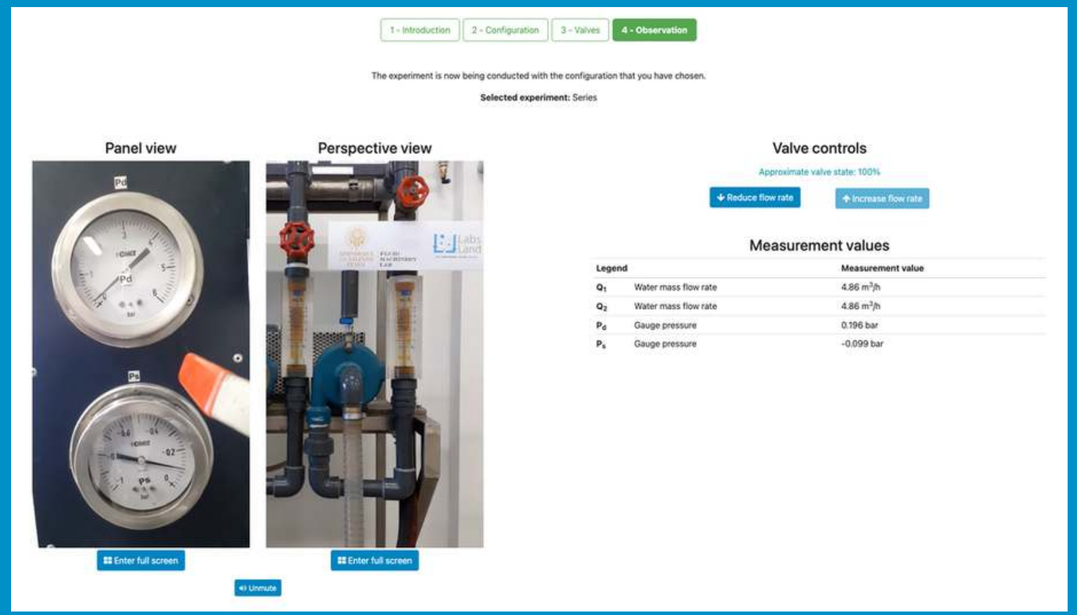
Sonometer

- With this device you will obtain instantaneous values in real time to assess the acoustic comfort conditions and limit values associated with different professional activities.
- In order to measure noise, we will use the PEAKTECH 8500 sound level meter as a measurement tool.
- This compact equipment offers great versatility when it comes to taking measurements in indoor and outdoor spaces, and to instantly know the sound conditions produced by different sources in a room, a space or a workplace.



Centrifugal Pump

- They are used in many areas to transport fluids.
- This lab allows you to control a centrifugal pump, which is placed in a circuit configurable by valves.
- The valves allow you to configure it in series or in parallel.
- In addition, you can test the effect of cavitation, under certain configurations.



Pelton Turbine

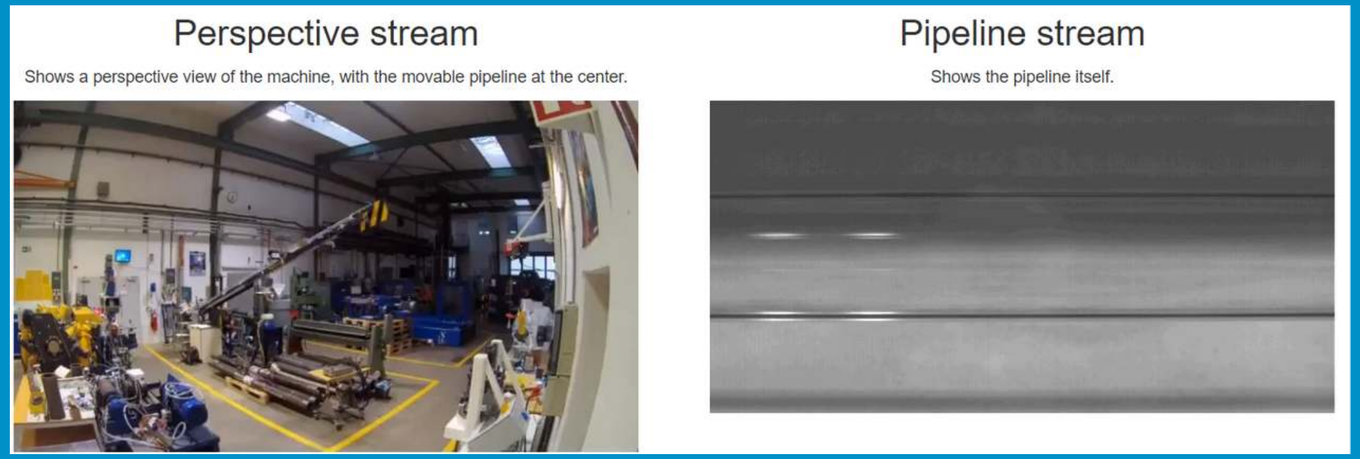
This lab allows you to experiment with a Pelton Turbine by varying basic parameters such as aperture and RPM and. observe the output, generating electricity and measuring it

Texture Analyser

- Analyse the texture of foods and measure some of their physical characteristics with this laboratory instrument.
- You can use this laboratory instrument to analyse the texture of fresh and processed foods, as well as industrial products, as it can measure a wide range of physical parameters.

Flowloop

- The Multi-Phase Flowloop laboratory lets you carry out experiments to visualize flow patterns of multi-phase systems that develop in production tubing in possible real-life scenarios. Through variation of the water flowrate and the angle of the tubing itself, you can appreciate the forming of different flow patterns or “cuttings” depending on the chosen values.



Chemistry Laboratories

Gay-Lussac's Law

- Gay-Lussac's law is a law that allows the study of the behaviour of gases and is commonly studied in physics and chemistry.
- It relates the pressure of the gas to the temperature, while keeping other parameters such as the volume and the amount of substance constant.
- In this experiment, it will be shown that, for a given amount of gas, the pressure is directly proportional to the temperature.

Boyle's Law

- Boyle's law is a law that allows the study of the behaviour of gases and is commonly studied in physics and chemistry.
- It relates the pressure of the gas to the volume, while keeping other parameters such as temperature and the amount of substance constant.
- In this experiment, it will be shown that, for a given amount of gas, the pressure is inversely proportional to the volume.
- The experiment is carried out at room temperature and constant, in the graphical analysis this behaviour is reflected in an isotherm.

Acid-Base Titration (v1)

- Perform an acid-base titration to determine the concentration of an unknown citric acid solution using a sodium hydroxide titrant. A digital pH sensor is always available and a phenolphthalein indicator has been applied to the unknown solution so that both a potentiometric and colorimetric approach can be used. A real-time plot is also available.

Screen view

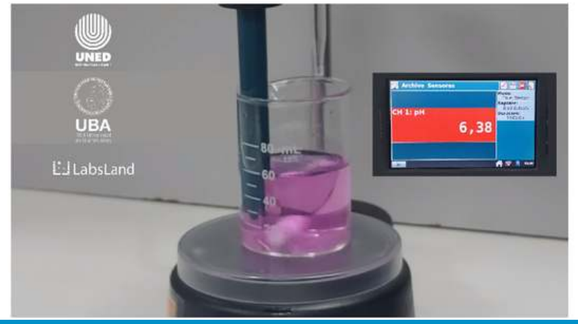
Perspective view

Acid-Base Titration (v2)

- Perform an acid-base titration to determine the concentration of an unknown acetic acid solution using a sodium hydroxide titrant. This laboratory emphasizes visual measurements dealing with the meniscus of the burette, and supports two different configurations.
- The first one is for a potentiometric approach: you will have access to a digital pH sensor and you can use it to determine when the unknown solution has been neutralized.
- The second one is for a colorimetric approach: you can rely on the color change due to the presence of a phenolphthalein indicator, without having a digital pH sensor available.

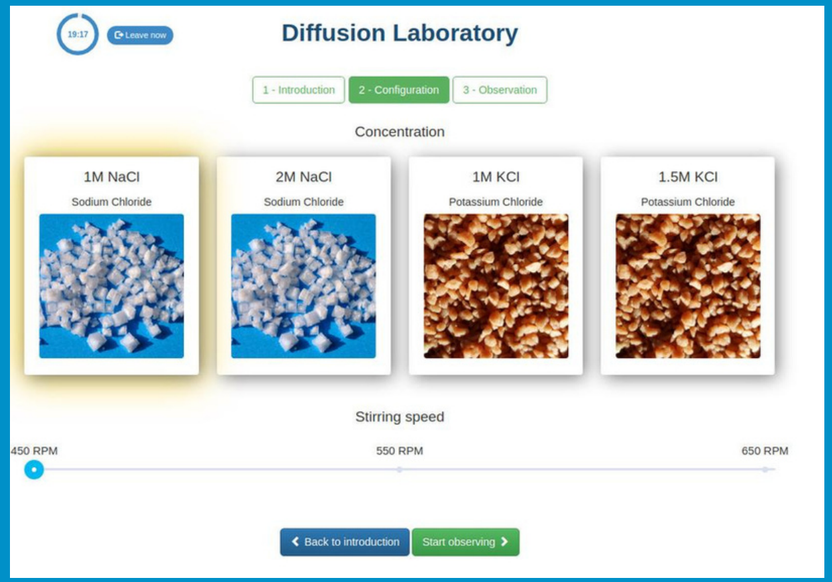
Front view

Close view



Diffusion

- Diffusion is an irreversible transport system of molecules and solutes, in which molecules move from an area of high concentration to an area of lower concentration. This movement is continuous unless the temperature is 0 absolute.
- Diffusion allows a gas or substance in solution to expand to fill the entire free volume. The origin of diffusion is the natural movement of molecules.



Exchangeable Acidity of Soils

- The acidity of soils can occur due to various processes that promote a pH reduction. The main sources of soil acidity are associated to hydrogen ions (H+) and aluminum ions (Al+3) in the soil's solution. Exchangeable acidity is determined through the use of neutral salts solutions such as potassium chloride (KCl). The acid ions (H+ and Al+3) that are held in the colloidal fraction of the soil, that in the presence of a displacing ion (K+), makes those enter the soil solution. Afterward, that solution is titrated with a sodium hydroxide solution of the exact concentration to reach the last point of the neutralization reaction using phenolphthalein as an indicator.

Water Heating and Cooling Curves

The Water Heating and Cooling Curves of Water laboratory allows students to heat or cool a mass of water with different intensities, and measure the temperature continuously. It is thus possible to create a plot with the resulting temperature-time curves, and thus obtain conclusions regarding the transfer of energy and matter state changes.

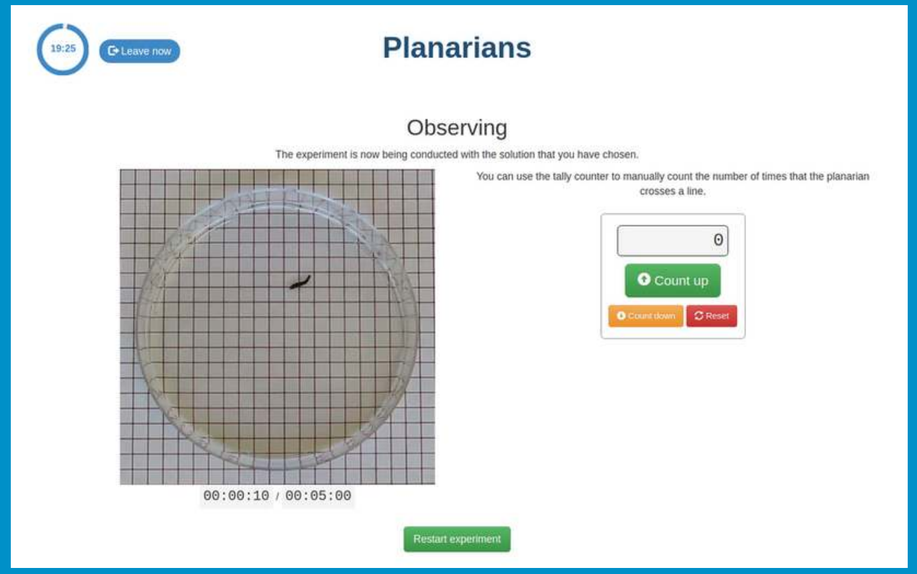
Process camera

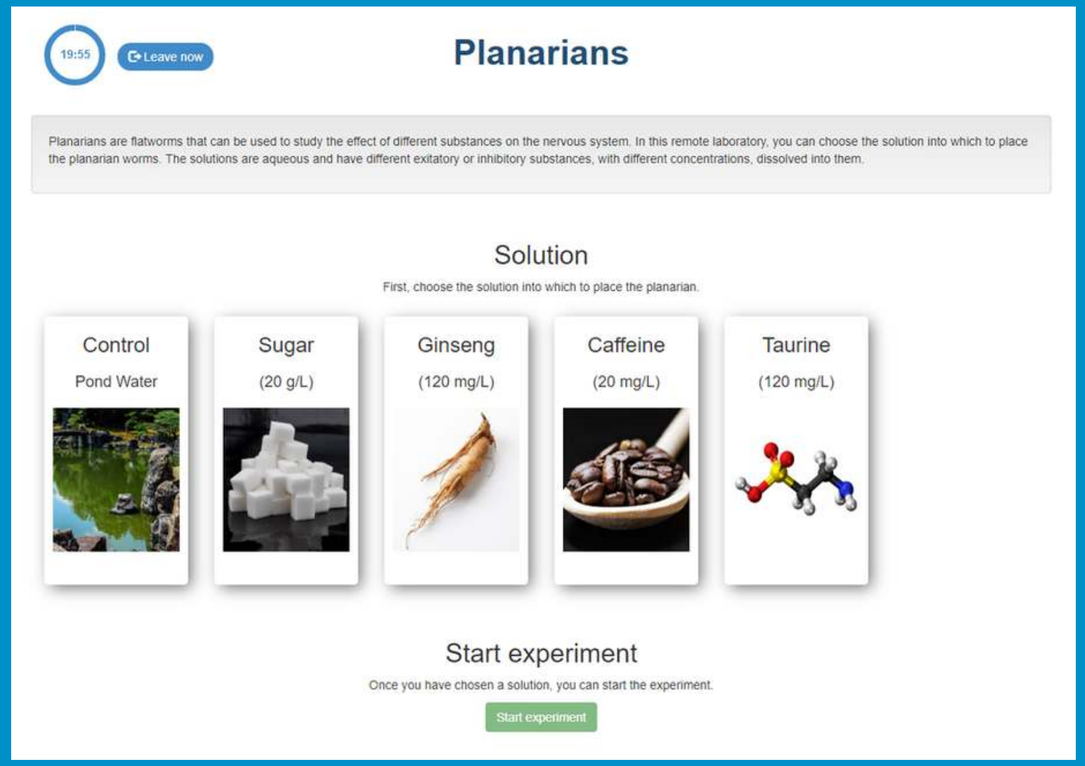
Temperature camera

Biology Laboratories

Planarians

- Planarians are a class of flatworms that can be used to study the effect of different substances on the nervous system.
- In this remote laboratory, you can choose the solution in which to place the worms. The solutions are aqueous and contain different excitatory or depressant substances, with different concentrations.
- There is a hand-held counter that the students can use to count the number of times the planarians cross a line.





2. Remote Laboratory Hardware

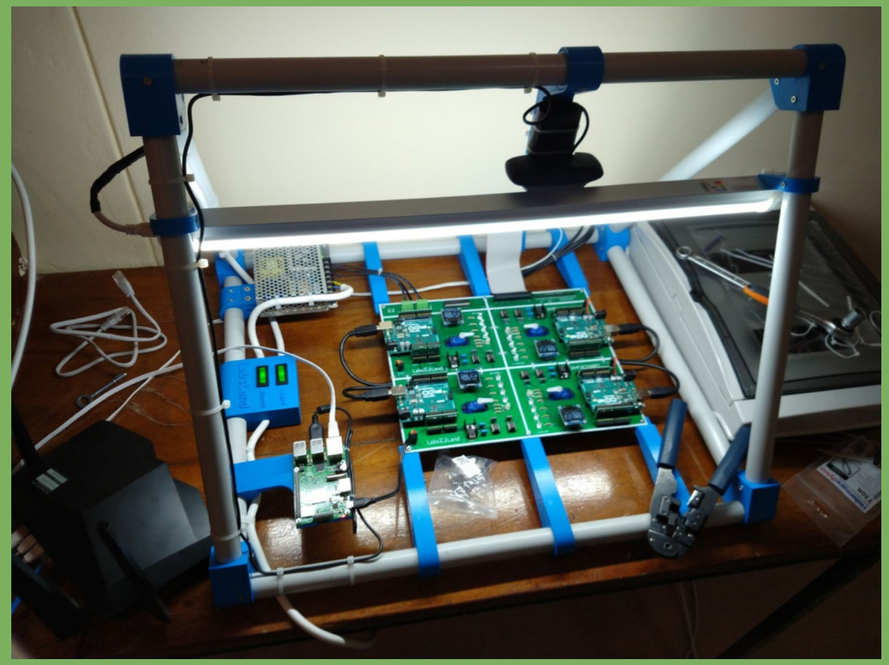
This section lists the different hardware products for remote laboratories. The products included here are generally hardware developed by LabsLand, not available from other suppliers. The hardware is to be deployed in the client institution. Normally, through this, the client institution is incorporated into the network. Depending on the conditions under which this is done, it will have access to the rest of the network laboratories of its type, or it will only have access to its own. The equipment includes a variety of proprietary software.

Arduino Robot

- The Arduino Robotics Lab is the equipment used for LabsLand's Arduino Robotics Lab, both in its traditional code version and in its visual code version based on Google Blockly.
- The equipment consists of two sub-instances of the Arduino Robotics lab. That is, a single instance has two bases and two robots, so that it can be used at the same time by two users.

Arduino Boards

- The Basic Arduino Lab is the equipment used for LabsLand's Basic Arduino Lab, both in its traditional code version and in its visual code version based on Google Blockly.
- The Arduino Basic lab allows programming, controlling and visualising Arduino UNO development boards, which are also connected to various peripheral components.

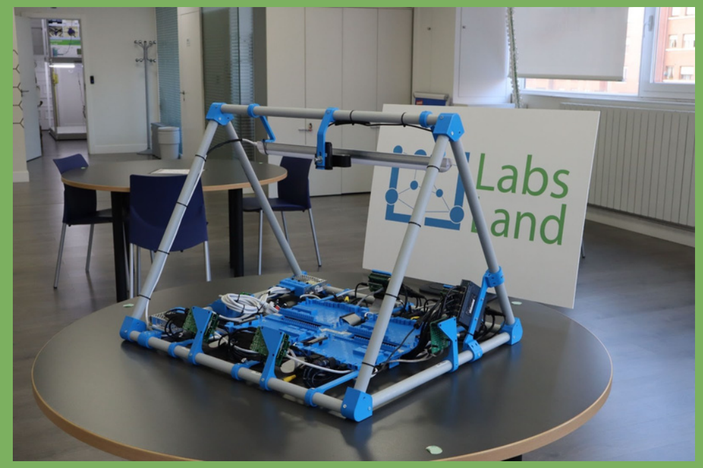


Intel DE1-SoC Boards

- The Intel FPGA Lab - DE1-SoC is the equipment used for the Intel FPGA Lab at LabsLand. It supports VHDL, Verilog and in some cases additional hardware definition languages. This lab is based on the Terasic DE1-SoC development board, which incorporates an Intel/Altera Cyclone V SoC FPGA.
- One unit of the equipment consists of four sub-instances of the lab.
- The lab has four DE1-SoC development boards, remotely programmable and viewable from the remote interface. Each development board has its own peripherals and those added by LabsLand.

Intel DE2-115 Boards

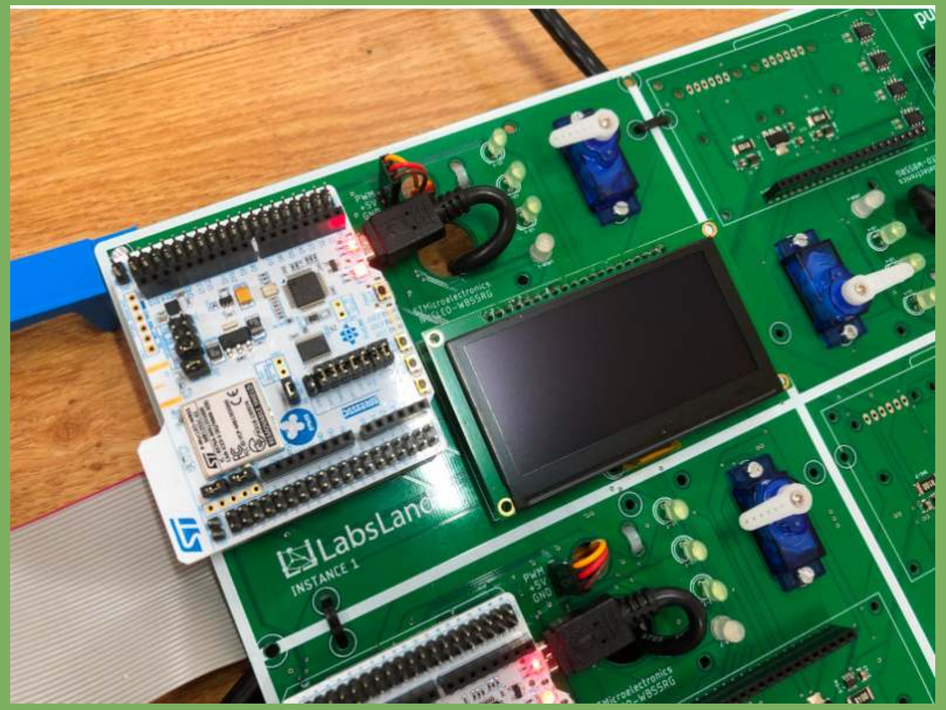
- The Intel FPGA Lab - DE2-115 is the equipment used for the Intel FPGA Lab at LabsLand. It supports VHDL, Verilog and in some cases additional hardware definition languages. This lab is based on the Terasic DE2-115 development board, which incorporates an Intel/Altera Cyclone IV FPGA.
- One unit of the equipment consists of four sub-instances of the lab.
- The lab has its own DE2-115 development boards, remotely programmable and viewable from the remote interface. Each development board has its own peripherals and those added by LabsLand.



ST Nucleo WB55RG

- Physical structure that includes cameras, lights, controllers, network switches and software.
- Designed for 8 Nucleo WB55RG boards.
- Servomotors, LEDs, potentiometers, current sensors and much more.

.

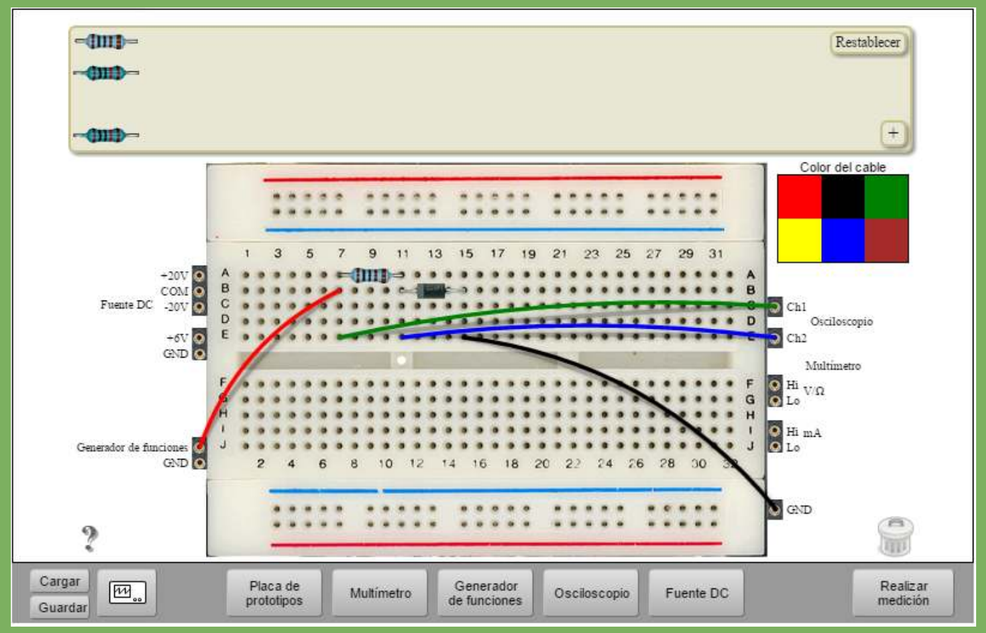


TIVA Launchpad with tm4c129

- Physical structure that includes the cameras, lights, controllers, network switches and software.
- Designed for 8 TIVA Launchpad with tm4c129 boards.
- Multiple sensors and actuators, both real and virtual.

Analog Electronics lab

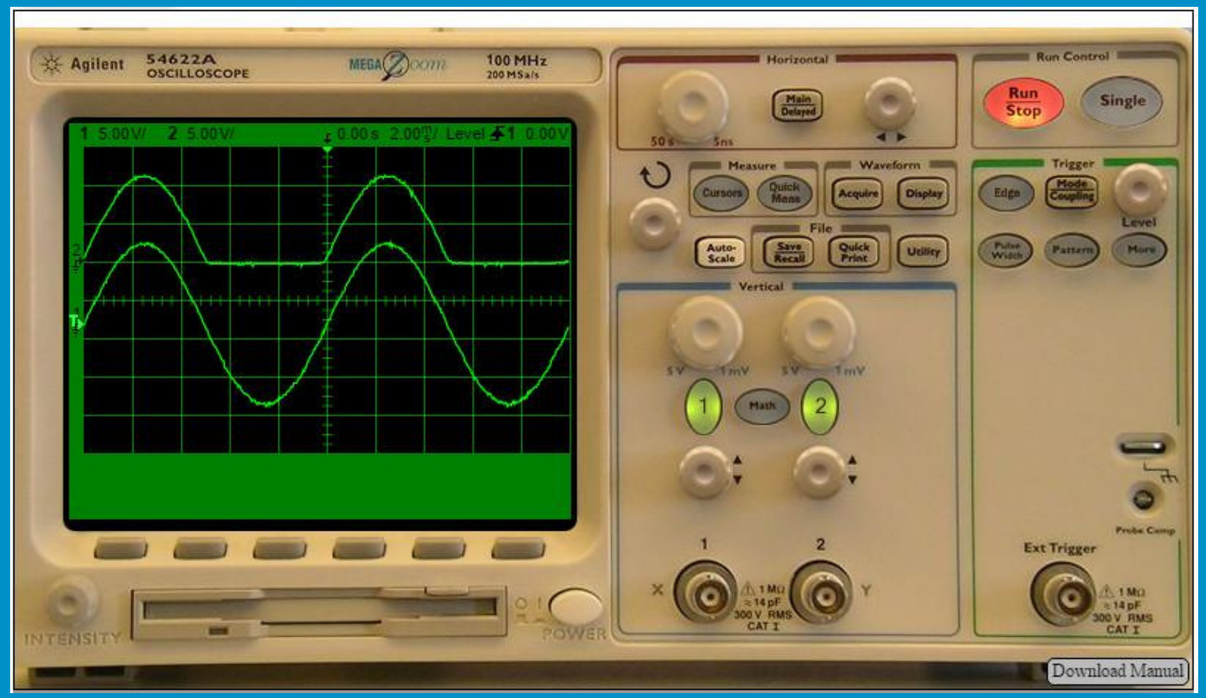
- Structure where you can build your own electric circuits
- Included components: resistors, capacitors, diodes, transistors and more
- Different instruments: oscilloscope, multimeter, power supply and more

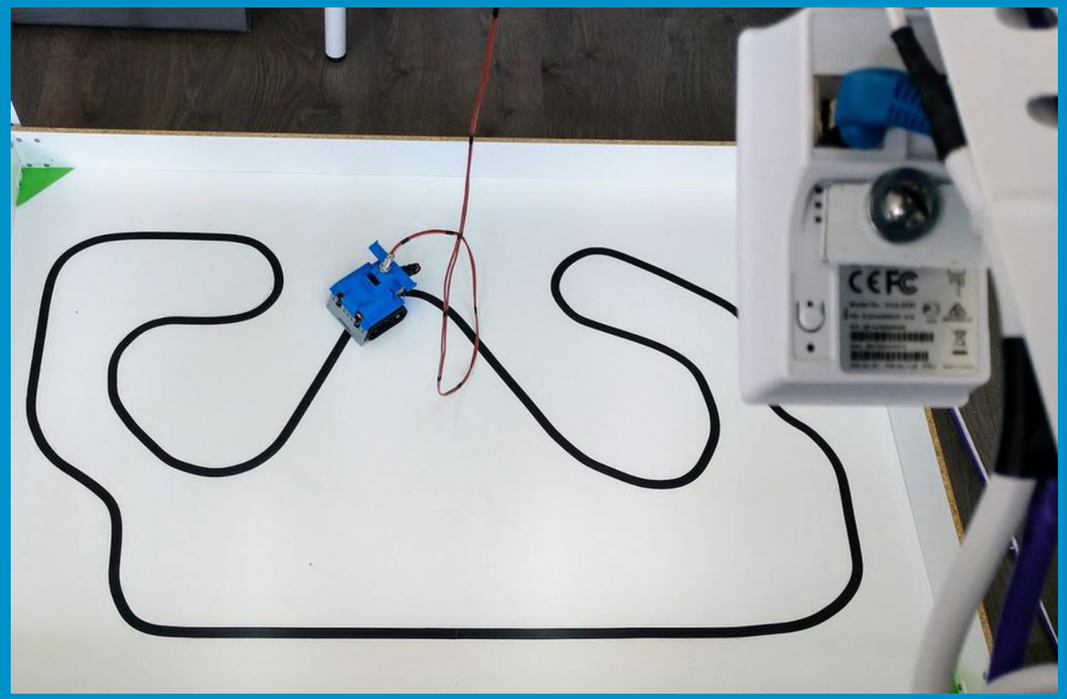


3. Additional Services

Creation of real-time labs

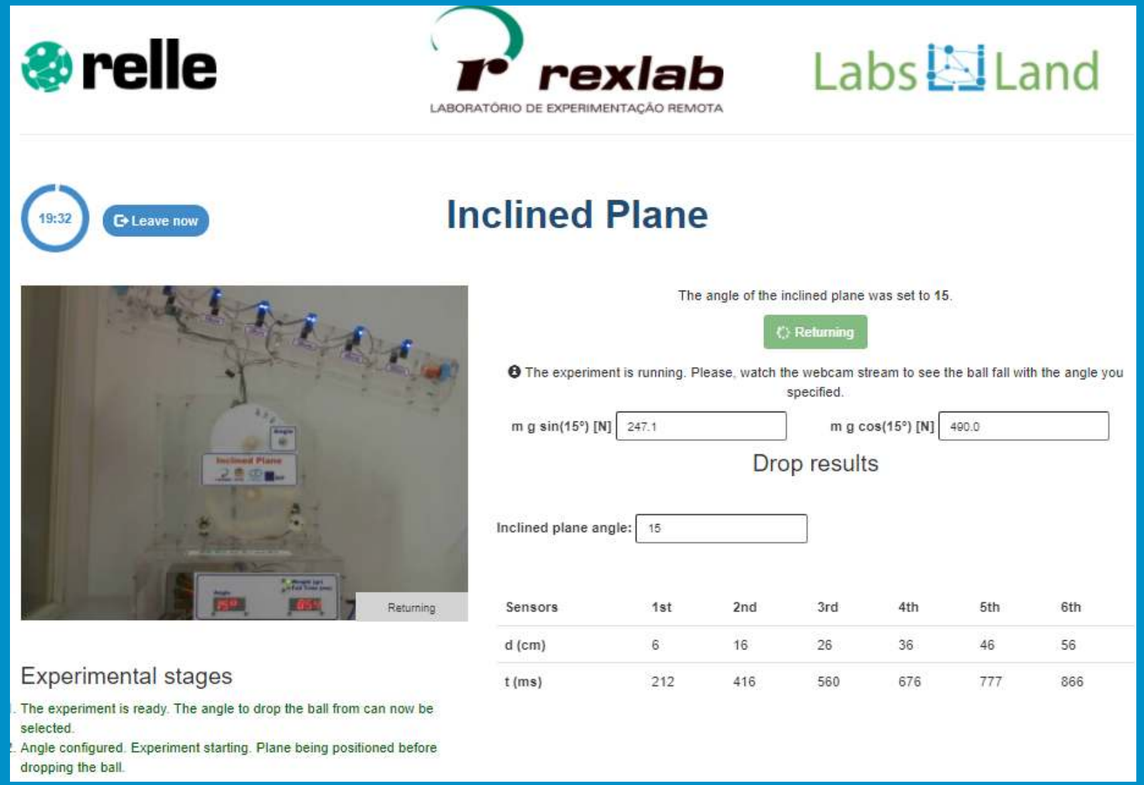
In real-time labs, students access the equipment as things are happening: in the case of the robot, they send a programme to a robot and see how the robot behaves with their programme in real time elsewhere on the Internet.





Creation of ultraconcurrent labs

The deferred laboratories are based on a set of pre-recorded experiences carried out in a real laboratory. Thus, the interface of a deferred lab allows the student to have the same experience as in a real time lab. All the data is completely real, but this way you can use it with a whole class and more robustness at the same time.



Contact us

https://labsland.com
contact@labsland.com