



## I Science Connect Multiplier Event

# Teaching of Sciences: a challenge to overcome

**ERASMUS + PROJECT REF. No. 2019-1-RO01-KA201-063162**

ID of the project: E1 (Multiplier event)

April 29<sup>th</sup>-30<sup>th</sup>, 2022

Faculty of Sciences of the University of Porto

Porto, Portugal.

## **I Science Connect Multiplier Event**

Abstracts and digital publications of the meeting

### **Date and place:**

April 29<sup>th</sup>-30<sup>th</sup>, 2022

Faculty of Sciences of the University of Porto

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## I Science Connect Multiplier Event

The I Science Connect (SciCon) Multiplier Event “Teaching of Sciences: a challenge to overcome”, is part of ERASMUS + project REF. No. 2019 - 1 – RO 01 - KA201 – 063162 (ID of the project: E1 - Multiplier event). The SciCon project aims to develop digital skills in secondary school students and teachers.

The event is a workshop planned for two days and is organized under the coordination of the University of Porto, through the Department of Physics and Astronomy of the Faculty of Sciences.

The event intends to present innovative ways to bring students closer to studying the sciences as an integrated domain. For this approach, activities carried out during the project were presented, as well as the intellectual outputs and contributions from abroad in the fields of Application for Virtual Laboratories, digital resources, Programming and Arduino.

The Multiplier Event is targeted for two types of participants: Portuguese teachers who teach science disciplines and practitioners who work in the field of Education, Training, and Management in face-to-face, blended and elearning scenarios. The reason for selecting these practitioners as a target is that in a time of significant scientific discovery, the pedagogical dimension needs to be brought to the forefront of teaching/learning and learning processes for Science understanding and its role for the society; International workshop participants partners of the organizing institution, faculties of science or pedagogy with whom the Department has scientific and collaborative contacts. Through these participants, the Intellectual Outputs will penetrate into international educational environments, which will represent a new dimension of project addressability.

The goals of the multiplication events are:

- to disseminate the results by improving the international dimension of the project
- to provide participants with tools and methods useful to the innovative approach of science teaching, with the student as the center of the action
- to share the intellectual output of the project
- to share experiences and results
- to explore new areas of cooperation between the participants

The Event has Portuguese and English as official languages. Presentations were in person or remotely, in Portuguese or English.

Organizing Committee  
I Science Connect Multiplier Event  
Faculty of Science of the University of Porto

## AGENDA

### **Day 1: April 29** (online)

- 16:00 – 16:30: Opening Ceremony and general presentation of the project done by the Project Coordinator
- 16:30 – 17:30: Session C1: Video presentations of the project's activities developed by each school involved in the project (Portugal; Spain; Italy)
- 17:30 – 17:50: Coffee break
- 17:50 – 19:10: Session C1: Video presentations of the project's activities developed by each school involved in the project (Romania; Turkey; Greece; Latvia)
- 19:10 – 19:30: Presentation of Open Educational Resources done in the project by UPORTO team
- 19:30 – 19:45: Closing Ceremony of the first day of the event

### **Day 2: April 30** (in person and online)

- 14:30 - 14:45: Opening Ceremony of day 2 by the local coordinator of UPORTO
- 14:45 - 16:00: Session C2: Oral presentations of practical activities by participants of the project
- 16:00 - 16:15: Coffee break
- 16:15 - 17:45: Session C3: Oral presentations of practical activities by participants of the project
- 17:45 - 18:15: Workshop 1: Teaching Astronomy with Ozobots
- 18:15 – 18:45: Workshop 2: Algodoo - an alternative to interactive virtual labs
- 18:45 - 19:00: Closing Ceremony by the Project Coordinator

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# Extended Abstracts

## CREATIVE ROBOTICS AND CREATIVE WORKSHOPS

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### Abstract

The Erasmus+ experience allowed us to investigate the benefits on learning deriving from the application of information and robotics technologies within a context that is not necessarily the school, experiencing the consequences of using new methodologies in various contexts. The reference is in particular to Tracker, Ozobot and Arduino. With Tracker we discovered new laboratory experiences in a curricular subject, the other two instead required an extra effort because they were not included in the programming. In a context of great involvement and strong stimulus, the students calculated the gravity acceleration  $g$  in the fall of an object and went further. By an old video about experiments on the Moon, students measured the acceleration on our satellite. By Ozobot, students built a labyrinth and, putting two sensors controlled by the Arduino board, it was possible to determine the robot travel time. The activity became a game and the aim is to make Ozobot reach as many exoplanets as possible, without ending up in a black hole, in the shortest time possible. Curiosity is essential, but it needs new tools and specific skills to build up innovative learning.

**Keywords:** curiosity, discovery, tools

### INTRODUCTION

The Erasmus+ program as a matter of fact represents a teaching and learning methodology that is recognized as necessary for achieving, through lifelong learning, the formative, professional and personal development of the students in the field of education in Europe and all over the world.

All the activities included in the Erasmus+ programs have contributed and are contributing to sustainable growth, quality of education and social cohesion, but especially to promoting innovation and enhancing European identity and active citizenship, giving place to a greater motivation and satisfaction in the education field, for both students and teachers. The Erasmus+ program is a strategic project that is at the basis of European cooperation in the field of education aimed at a new dimension of European and world citizens.

The different choices in the different Erasmus+ programs take sometimes schools to deal with subjects and competences that don't belong to the school curriculum. This challenge takes to learn major competences to which otherwise students wouldn't have accessed, or they would, but in different ways. This is the experience the students from Martino Filetico in Ferentino had with the Science Connect project; there were two groups coming from different curricula, a group coming from Classic Liceo in which they don't go in deep at scientific and IT subjects, and a group coming from Scientific Liceo specializing in IT subjects. All the students had in common high competences in the use of technology, a feature that characterizes the students of Martino Filetico. The preparatory phases and events were a continuous discovery, in particular because the final products were not included in the teachers' school programs. The discovery of Tracker and Ozobot, the application of Arduino in unusual contexts have motivated and pushed the team to achieve always more difficult goals, with very interesting results respect to the everyday learning programs: learning can be for sure funny and involving, the school opens the doors towards the new, towards sharing, that is the basis of social dimension in the job field, towards lifelong learning.

The students were helped by a teacher of Maths and Physics that learned how to use Tracker, Ozobot and Arduino in the courses organized for the Science Connect project by Mr. Paulo Simeão Carvalho. Then, there was a study on the handbooks regarding the instruments and the applications and regarding the network. From this we took inspiration



for realizing the products. All the rest came from the creativity and ideas of students and teacher.

## METHODOLOGY

In order to reach the objectives we used different learning methodologies: cooperative learning, metacognitive learning and peer to peer learning. Using the cooperative learning the activities are carried out dividing the students in groups and working in mutual cooperation; using the metacognitive learning you teach the students to be aware of the learning processes involved in the learning itself; using the peer to peer cooperation all the components of the team (students and teachers) are on the same level to give place to a circular learning.

All the methodologies have in common the objective to overcome the traditional frontal teaching in order to have a mutual help in a positive and stimulating environment, where also the teacher has the role of facilitator to increase the student autonomy.

## RESULTS and DISCUSSION

Two in particular were the objectives achieved in the two mobilities of the Science Connect project in Italy and Turkey.

The objective of the Erasmus+ project in Turkey was to calculate the gravitational acceleration on the Moon through the analysis of a video of last century recorded on the Moon, showing that without gravity Galilei's law on falling objects is true.

In 1971, during the fourth landing on the Moon, in the final phase of an extraveicular mission, Captain David Scott decided to carry out an empirical demonstration. The astronaut dropped in front of a videocamera two objects with different mass without a resistance: a geological hammer weighing little more than a kilo and a hawk feather. The video shows the validity of Galilei's principle that two bodies fall on the ground independently from their weight, they fall on the ground with the same acceleration.

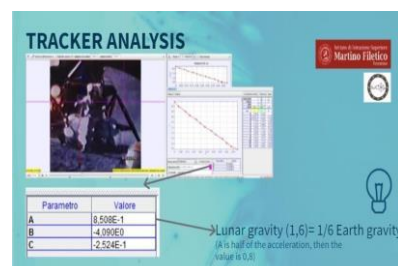
This event gave place to the curiosity of measuring gravity acceleration on the Moon. How could we do that? The answer was "let's try using Tracker"! And the result was surprising.

Using Tracker we uploaded the video taken from YouTube Pic.1, at the link <https://youtu.be/xF8hEUKjauY>, analyzed the hammer and feather fall and compared the corresponding information inferable with the software. Through Tracker:

1. Select the position of the object in the first shot of the recording
2. Select the following positions of the falling object, shot by shot (object tracing)
3. You will get a table with the space intervals and the corresponding times got by the data analysis software in a column. Pic.2
0. You will get a graph representing the space positions of the object as a function of time. Pic.2
0. You will carry out a quadratic fit  $y=At^2+Bt+C$  of space-time data that is an experimental representation of the law of the motion. Pic.2
6. From the coefficient of the term in  $t^2$  of the equation resulting from the fit you will obtain (multiplying twice) an estimated gravity acceleration in  $m/s^2$ . Pic. 2



Pic.1 Captain David Scott drops the hammer and the feather



Pic.2

And, as you can see in Pic.2 the value of  $g$  obtained is 1,62 m/s<sup>2</sup>: a result that was not expected, at first it was only a challenge, a discovery that amazed, since with the analysis of a Galileo's theory all the team felt as a protagonist of the history of Physics. For the Erasmus+ an interactive activity was studied to be able to link Ozobot and Arduino potential. The first objective was to combine the colour code, to make it possible for Ozobot to accomplish the complete ride and then, with Arduino, program a system to calculate the time spent by Ozobot to complete the ride, touching all the European flags.

For this purpose we used: an Arduino board UNO, 2 photoresistors, one breadboard, some cables, a cardboard box, a map for ozobot, an ozobot.

1. Place all the components on the box that will be a support, paste the Arduino board and the breadboard inside making a hole to insert the cable that connects Arduino to the computer. Pic.3
2. Paste ozobot path on the external part of the box. Pic.3
3. Referring to the initial and final points of the path, create (start/End) two small holes inside which you can place two photoresistors. Pic.3
4. Connect the cables with the breadboard to Arduino and then the breadboard with the photoresistors (brightness sensors). Pic.4
4. Once completed the hardware let's deal with Arduino software. Pic. 4

**Sketch Arduino**

[https://drive.google.com/file/d/1NTdjYn0SbEdZ6lcd6q9\\_M1kfdRbYONNx/view?usp=sharing](https://drive.google.com/file/d/1NTdjYn0SbEdZ6lcd6q9_M1kfdRbYONNx/view?usp=sharing) : this is a video of the complete project

	<pre>int fotor1=A0; int fotor2=A1; int luce1=0; int luce2=0; int k=0; bool control1=false; bool control2=false;  void setup(){   Serial.begin(9600);   pinMode(fotor1,INPUT);   pinMode(fotor2,INPUT); }</pre>	<pre>if(l2&lt;ght    &amp;&amp; control1==true){   t2=millis();   control2=true; } if(control1==true    &amp;&amp; controllo2==true){   dt=t2-t1;   secondi=dt/1000;   Serial.print("    time difference in seconds is ");   Serial.println(seconds) ;   Serial.print("    time difference in milliseconds is ");   Serial.println(dt);   control1==false;   control2==false;   t1=0;   t2=0;   dt=0;   seconds=0;   k=k+1; } }</pre>
<p>Pic.3 internal of the box containing the material</p>	<pre>unsigned long t1,t2,dt; float seconds; void loop(){  while(k==0){   light1=analogRead(fotor1);  if(light1&lt;500){   t1=millis();   control1=true; }   light2=analogRead(fotor2);</pre>	
<p>Pic.4 external of the box where we can see the sensor from the beginning to the end</p>		

Now the team thought to insert the path in a game. The winner is who succeeds in combining the colour code to reach the flags in less time. Good luck!

**CONCLUSIONS**

The activities allowed to reach important objectives and competences: the knowledge of Tracker and its application in kynamics and dynamics, coding with ozobot and programming with Arduino; group work; development of curiosity as intuition and means for discovery, sharing the results with other students and understanding the importance of learning to learn , since only school cannot be able to teach all the knowledge. Everybody

was asked to deepen autonomously topics that are not part of the national curriculum. The students from Classic liceo helped using their argumentative skills, while the students from Scientific liceo helped using their IT skills. The teacher had the task to guess the personal inclinations of the students and to coordinate them, without leaving anybody apart, motivating the students to the taste of discovery and the freedom to express their own ideas respecting the scientific method, your lighthouse if you want to act correctly in the scientific research.

## REFERENCES

- Paulo Simeão Carvalho, 2019, Atti degli workshop "Tracker", Maya (Portugal)
- Paulo Simeão Carvalho, 2019, Atti degli workshop "Ozobot end Aduino", Maya (Portugal)
- Giovanni Organtini, 2021, Fisica con Arduino, Ed. Zanichelli
- Internet sites: <https://physlets.org/tracker/> ; <https://play.inaf.it/ozobot-labirinto-esopianeti/>

## PLANETS, FREE THROW WITH SCRATCH

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### Abstract

Scratch is a high-level block-based visual programming language and website aimed primarily at children as an educational tool for programming, with a target audience of ages 8 to 16. Scratch was created by Mitch Resnikhead of the Lifelong Kindergarten group at MIT Media lab and is available for free download. The Scratch interface is divided into three main sections: a stage area, block palette, and a coding area to place and arrange the blocks into scripts that can be run by pressing the green flag or clicking on the code itself. Users may also create their own code blocks and they will appear in My Blocks. Our solar system consists of our star, the Sun, and everything bound to it by gravity – the planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune; dwarf planets such as Pluto; dozens of moons; and millions of asteroids, comets, and meteoroids. Each planet, moon and asteroid have their own gravitational pull defined by their density, size, mass, and proximity to other celestial bodies.

### I. INTRODUCTION

Side shot is the movement of a body in a homogeneous vertical gravitational field, when we drop it with an initial velocity that forms an angle with the horizon.

Applying the principle of independence and superimposition of movements, using the kinematic equations, uniform rectilinear motion, uniformly accelerated / decelerated rectilinear motion and Newton's laws we study the side shot

### II. METHODOLOGY

**Scratch** is a high-level block-based visual programming language and website aimed primarily at children as an educational tool for programming, with a target audience of ages 8 to 16.

Scratch was created by Mitch Resnikhead of the Lifelong Kindergarten group at MIT Media lab and is available for free download.

The Scratch interface is divided into three main sections: a *stage area*, *block palette*, and a coding area to place and arrange the blocks into scripts that can be run by pressing the green flag or clicking on the code itself. Users may also create their own code blocks and they will appear in "My Blocks".

#### Code base

Scratch 3.0 is a completely new JavaScript-based codebase made up of multiple components such as "Scratch-GUI," now based on a library from [Blockly](#), "Scratch-VM," which interprets code, and "Scratch-Render," the rendering engine. The Scratch Blocks are made using Blockly.

#### Solar System

Our solar system consists of our star, the Sun, and everything bound to it by gravity – the planets **Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune**; dwarf planets such as Pluto; dozens of moons; and millions of asteroids, comets, and meteoroids.

Each planet, moon and asteroid have their own gravitational pull defined by their density, size, mass, and proximity to other celestial bodies.


### III. RESULTS and DISCUSSION

For our project we have created a menu with all the planets of the solar system, from which you have to choose one planet, and after that the data we have to initiate are the the initial speed, the initial height and the angle of the throw.

#### Planet List

1. Mercury
2. Venus
3. Earth
4. Mars
5. Jupiter
6. Saturn
7. Uranus
8. Neptune
9. Pluto

Pick a planet



What is the object's starting velocity (Only positive) ?

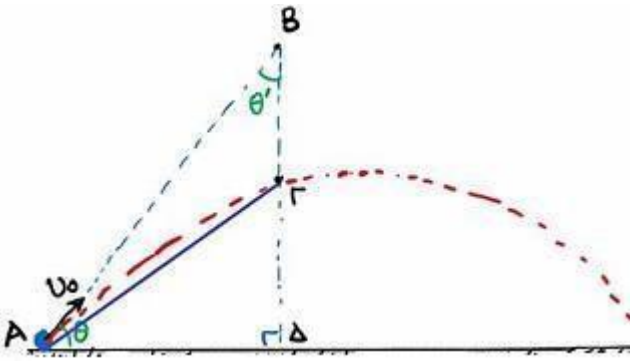
What angle is the object thrown at (In degrees)?

After entering the data, a menu appears from which you can choose one of six possible answers range, maximum height, position at point, height at point, horizontal position at a position, vertical velocity at a height

1.  $x_{\max}$  (range)
2.  $y_{\max}$  (maximum height)
3.  $x$  (position at a point)
4.  $y$  (height at a point)
5.  $v_x$  (horizontal velocity at a position)
6.  $v_y$  (vertical velocity at a height)

After that, an ozobot will show us the path the rock followed, in a diagram provided in real time.

Calculations



axe X  $U_{ox} = U_0 \cdot \cos(\theta)$

Part of the code

```

when I receive Ready
wait 4 seconds
go to x: 215 y: 25 h: 250
set object x to x position
set object y to y position
show
pen down
repeat 15
  glide 0.1 secs to x: object x + Vx * 0.4 y: object y + Vy * 0.4
  set object x to x position
  set object y to y position
  change Vy by g * 0.4
repeat until touching edge
  glide 0.1 secs to x: object x + Vx * 0.4 y: object y + Vy * 0.4
  set object x to x position
  set object y to y position
  change Vy by g * 0.4

```

**Formulas Used:**

$$v_x = v_0 \cos \theta \quad \{x = v_0 \cdot t \cos \theta\}$$

$$v_y = v_0 \cdot t \sin \theta - gt \quad \{y = v_0 \cdot t \sin \theta - \frac{1}{2}gt^2\}$$

$$y = x \tan \theta - \frac{gx^2}{2v_0^2 \cos^2 \theta}$$

$$y_{\max} = \frac{v_0^2 \sin^2 \theta}{2g}$$

$$x_{\max} = \frac{v_0^2 \sin 2\theta}{g}$$

$u_0$  = Starting Velocity

$u_x$  = Horizontal Speed

$u_y$  = Vertical Speed

$t$  = Time

$g$  = Acceleration of Gravity

$y_{\max}$  = Maximum Height

$x_{\max}$  = Range

$\theta$  = Angle of Throw

#### IV. CONCLUSIONS

Study of body motion in a homogeneous gravitational field with initial velocity. The constant vertical force acting on the body determines its orbit.

As we observe the motion of the body on the various planets we can draw some conclusions about the effect of the different acceleration of gravity on the planets in the motion of the body.

Furthermore, the change of the initial firing angle each time, affects the maximum height as well as the range that the body will reach.

Since the air resistance is negligible and there are no frictions of the mobile with the air, the motion equations on the x and y axes, the orbit of the body in the vertical plane as well as the beginning of the superimposition of the movements are confirmed.

#### V. REFERENCES

Phet Colorado, Projectile motion

<https://phet.colorado.edu/en/simulations/projective-motion>

<https://physicsgg.me/2021/04/11/> πλάγια βολή –το πήγαινε-έλα των βλημάτων

<https://photodentro.edu.gr/aggregator/lo/photodentro-lor-8521-8544>

<https://www.youtube.com/watch?v=SOYL2aJSLCA>

## REMOTE CONTROL ARDUINO CAR

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### Abstract

Remote Control Arduino Car is the project in which arduino board, engine, engine driver board, cables, power bank, remote control and IR Sensor were used. The body of the vehicle was modeled by using the program Tinker Cad. The body of the vehicle was printed using a 3D printer at Serçeşev Vocational and Technical High School's 3D Printing Laboratory. In the experiment, multiple tests were performed. The first test was done with the car's constant speed running at a flat level. Using brick foams, the "car's speed" was tested at different height levels with the wooden ramp, in order to get the results. Remote Control Arduino Car project proved that an object with a fixed weight and a fixed speed will change velocity travelling up at different inclines. In conclusion when the ramp was raised, the speed of the car decreased.

### I. INTRODUCTION.

Remote Control Arduino Car project was built in order to combine Arduino technology with Science. An Arduino Board, engines with wheels, a motor driver board to help control the engine wheels, cables, a power bank as the power source, a hand held Remote Control and an IR Sensor were used to build the car. Materials consisted mostly of electronic parts.

### II. METHODOLOGY.

TinkerCad program was used to create the shape of the body for the car (Figure 1).

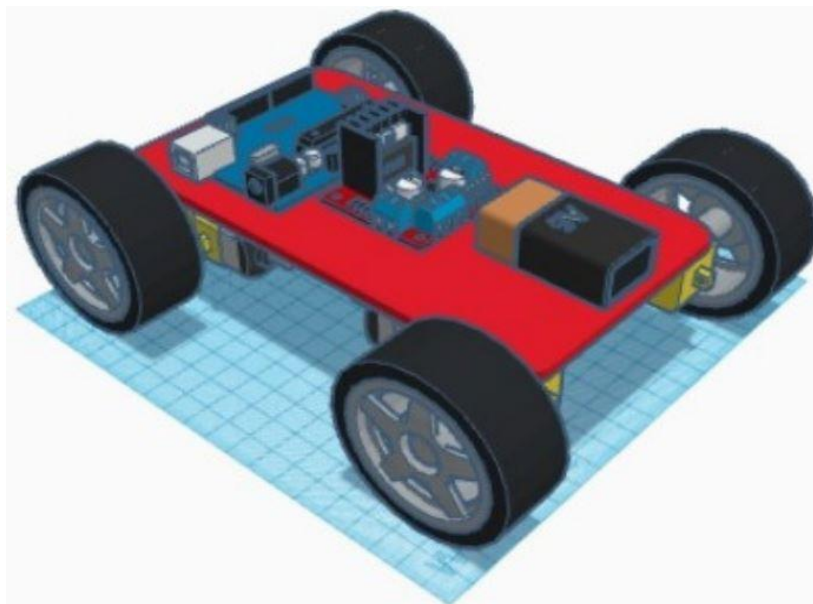


Figure 1: Body shape of the car using TinkerCad



A 3D printer was used to print the body of the car (Figure 2).

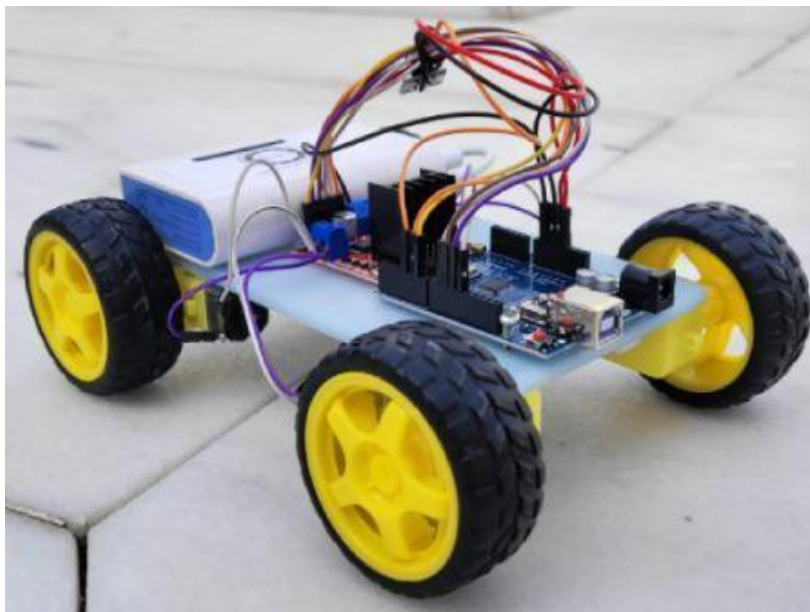


Figure 2: Car after the assembly was finished

To make it easy for all the Erasmus+ students, an instruction manual showing how to connect all the cables, Arduino board, motor driver board, power bank and engines was prepared. This picture is an example showing how all the materials were connected to each other (Figure 3). This is how it was shown in the instruction manual.

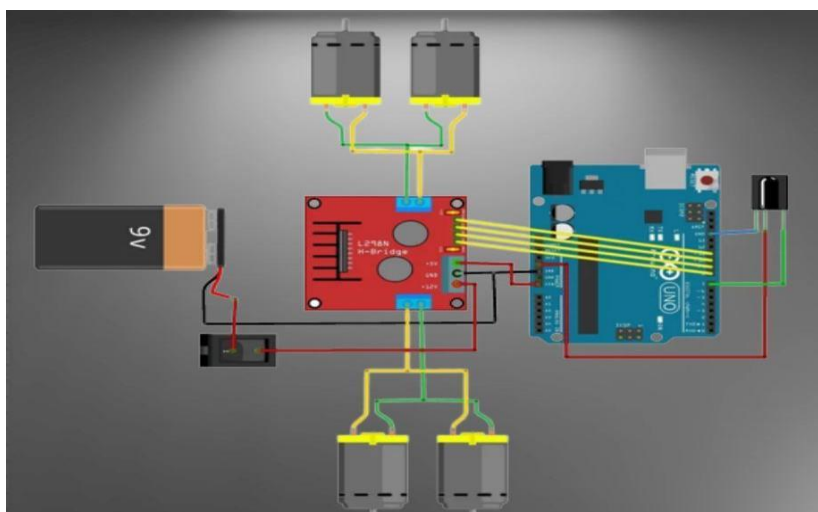


Figure 3: Arduino connections

To prevent students from making mistakes while trying to write the code for the Arduino, the already written program codes were provided to them by sending it to the students' PCs, automatically.

A wooden ramp was used to help provide a total of 3 different incline positions. The first test position was done with the ramp at a flat position. The car's speed remained constant during this test. For the second test position a total of 4 bricks, made with foam, were used to achieve a specific height. For the final test, the ramp was raised by using a total of 8 foam

bricks. This was the maximum height for the test.

### III. RESULTS and DISCUSSION.

Once the video data was gathered, the car's weight and the length measurement of the wooden ramp were entered in the Tracker program. This information is required in order to be able to take the necessary measurements for the Tracker program. These photos show the test results using the Tracker Program (Figure 4, Figure 5 and Figure 6).

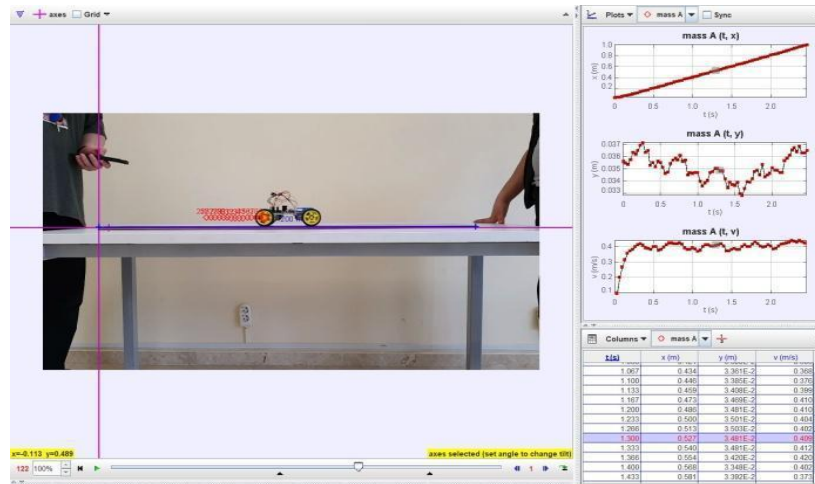


Figure 4: Ramp at a flat position

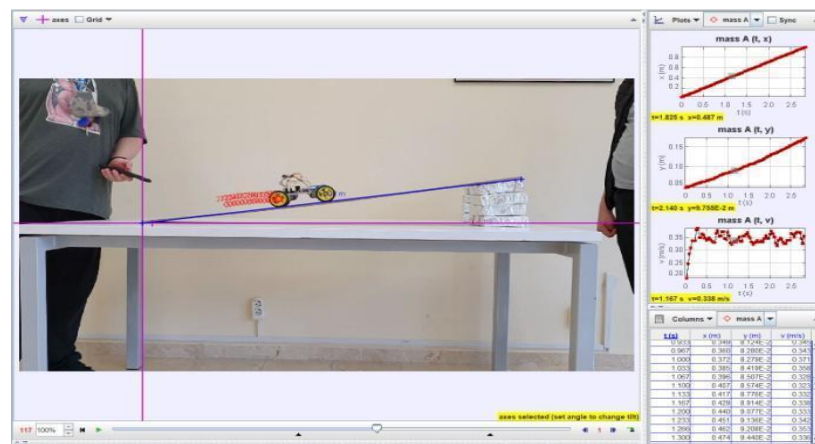


Figure 5: Ramp at first incline position (4 foam bricks)

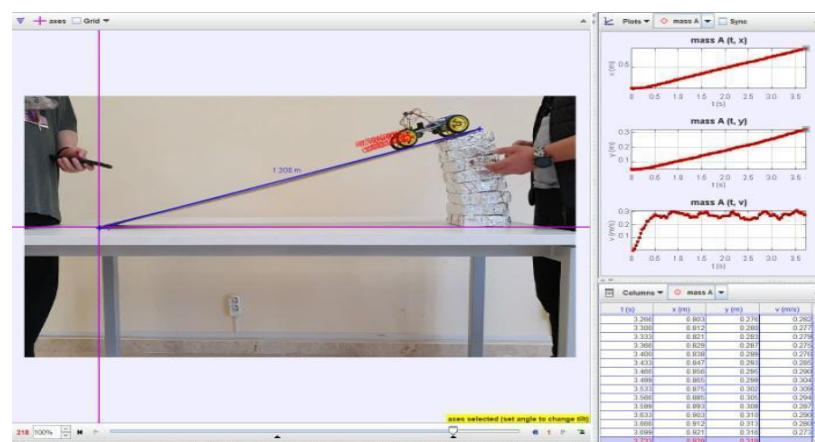


Figure 6: Ramp at maximum incline position (8 foam bricks)

The Arduino Car's speed was affected when the ramp was raised at different height position. When the car runs on any ramp height, the car's speed will slow down at any angle due to its weight and friction from the incline. When the car runs without any ramp height, the car's speed is constant and there is no reduction of speed.

There is a formula used to calculate the velocity of an object (Figure 7). This formula shows the velocity equals distance divided by time. This formula applies to the project by using the results of the Tracker graph's speed outputs.

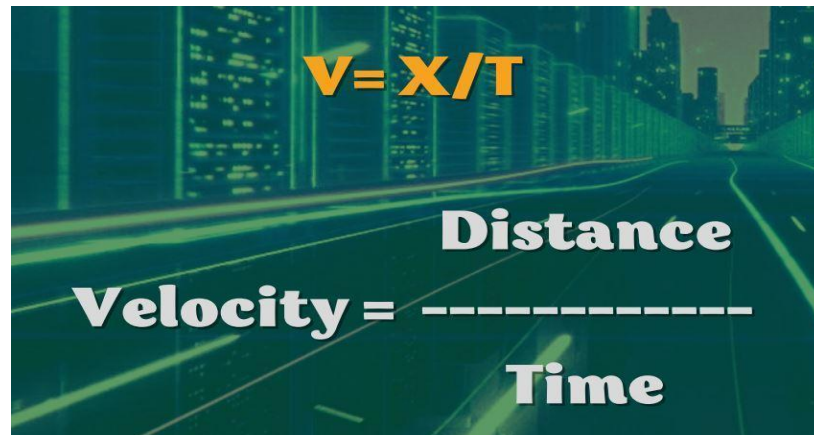


Figure 7: Formula to calculate velocity

#### IV. CONCLUSIONS.

After finishing the Tracker program test results, the main question to be answered was: If I raise the ramp, will the speed of the car slow down? The speed of the car is affected by the change of the ramp's height position.

Newton's 2nd Law of Motion was proven with this project. The law states that every object, like our car, PERSISTS in its state of rest or uniform motion in a straight line unless it is compelled to change that state by force impressed on it.

After completing the Tracker Graph analysis, the conclusion for the project is as follows: By commanding different actions to compensate for the vehicle's increased speed, it shows in the Tracker Graph how Newton's Second Law of Motion is supported.

#### V. REFERENCES.

Autodesk, Inc. ©2022 AUTODESK Tinkercad 3D design (<https://www.tinkercad.com/learn/designs>)

Douglas Brown, Wolfgang Christian, Robert M. Hanson. Tracker Video Analysis and Modeling Tool (Copyright © 2022) Windows Tracker download (<https://physlets.org/tracker>)

Electrosome, ©2021 DC Motor driving using H Bridge (<https://electrosome.com/dc-motor-driving-using-h-bridge/>)

Electrosome, ©2021 Interfacing L298N Motor Driver with Arduino Uno (<https://electrosome.com/interfacing-l298n-motor-driver-arduino-uno/>)

## SMART CHICKEN COOP PROJECT

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### Abstract

Smart Chicken Coop was our special project because we used Arduino, Ozobot and the Tracker program. We created a story by making a baby chick costume for Ozobot. We learned how to use Ozobot's programming in order to create the daily routine. Also, we began working with the Arduino programming. The Arduino components were needed in order to control the Smart Feeder for Ozobot and the Smart Door of the Chicken Coop. The Ozobot procedure was going to be the one to provide the information needed to be used in the Tracker program. Once we performed our test by taking video of Ozobot and using it with the Tracker program, we were able to get our results. When the Ozobot procedure was finished, we concentrated our efforts with the Arduino procedure in order to build Ozobot's Smart Chicken Coop place. This project taught us the importance of technology and science working together in order to achieve advances in life. When both, science and technology are used together, the possibilities of progress are unlimited.

### I. INTRODUCTION.

Smart Chicken Coop was a special project because **Arduino**, **Ozobot** and the **Tracker** program were used in this project. Arduino was used for the Smart Feeder Door and the Smart Door of the Chicken Coop. Ozobot was dressed like a chick and used as the chick living in the Chicken Coop and the Tracker program was used to analyze the Physics involved with the project, which Ozobot's color code speed programming helped provide the analysis and results.

First, a story was created by making a baby chick costume for Ozobot and then the path for Ozobot's daily routine was made. This routine consisted of waking up, leaving the nest area, using the Smart Feeder with the help of Arduino, going outside the Chicken Coop by using the Smart Door, then, run around the area for a relaxation time and finally coming back to the nest to go to sleep.

### II. METHODOLOGY.

How to use Ozobot's programming in order to create the daily routine was taught. The Chicken Coop template was created and other materials were used to start making the project's components. To save time, all the necessary components for all the teams participating in the Erasmus+ project were given. Also, the color codes and calibration circle were prepared for Ozobot's programming commands. These commands were used in order to control Ozobot's speed. The robot would read the color command and performed the specific task. The Arduino programming was the second procedure of the project. The Arduino components were needed in order to control the Smart Feeder for Ozobot and the Smart Door of the Chicken Coop. The Arduino was built inside the project box. At the same time, Arduino and the Ozobot procedures were also being done. The Ozobot procedure was going to be the one to provide the information needed to be used in the Tracker program. An extra Chicken Coop template was built to use as a display and demonstrate how to use the Ozobot for the project.

By taking video of Ozobot and using it with the Tracker program, the results were displayed (Figure 1). When the Ozobot procedure was finished, the Arduino procedure and the box were started. An Arduino instruction manual for all the groups of students participating in the Erasmus+ project was provided. Since the written code or programming for the Arduino was provided, this helped prevent any mistakes from occurring. Also, a small

bag containing Ozobot's color code speed commands was provided. The Ozobot's bags had random color code speed values like stop, 3 second pause, fast and turbo. Because of how the placement of the color code speed command was used, each group would have different results.

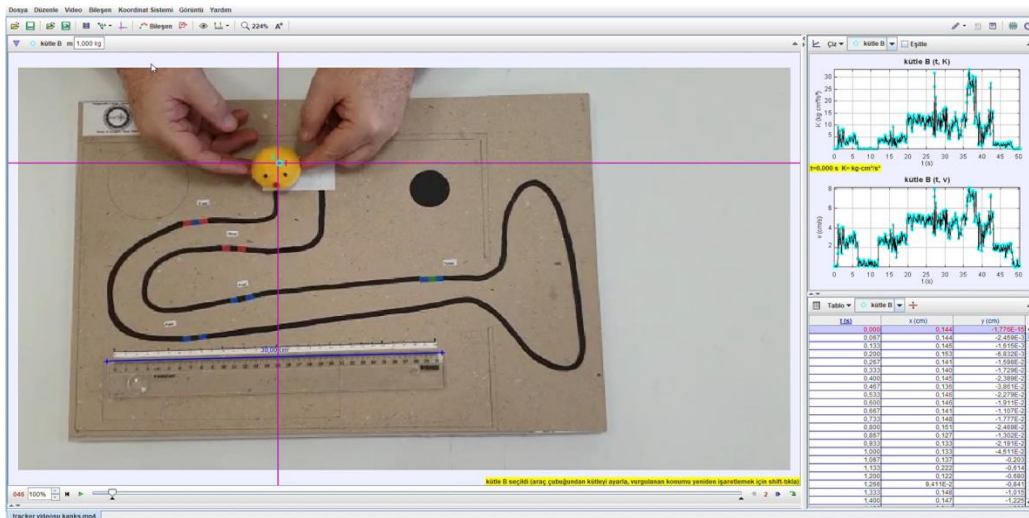


Figure 1: Tracker graph program

### III. RESULTS and DISCUSSION.

The project was divided into two parts. The first one was Ozobot and the second one was Arduino. In this project the color codes and calibration circle were prepared for Ozobot's programming commands (Figure 2). These commands were used in order to control Ozobot's speed. The robot would read the color command and performed the specific task. The black color calibration circles were used to help program the robot, in order to recognize the black color as the path guide to be followed and the outside color would be recognized as the no trespassing zone (Figure 3).

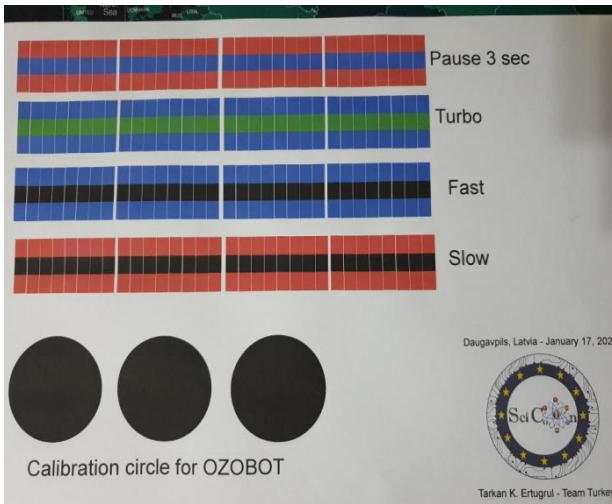


Figure 2: Color speed command & calibration circle.

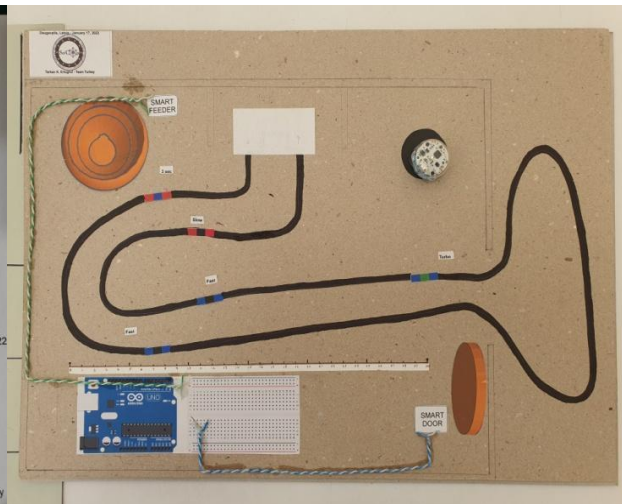


Figure 3: Chicken Coop template display.

Arduino was used to control the Smart Feeder Door and Smart Chicken Coop Door (Figure 4). Servo motors were used to power both doors. Arduino programming was used to control the doors' movements (Figure 5).



Figure 4: Smart Feeder and Smart Door Arduino connections.



Figure 5: Arduino programming.

#### IV. CONCLUSIONS.

This project taught the importance of technology and science working together in order to achieve advances in life. When both, science and technology are use together, the possibilities of progress are unlimited.

#### V. REFERENCES.

DroneBot Workshop. (Copyright © 2022) Using Servo Motors with the Arduino (<https://dronebotworkshop.com/servo-motors-with-arduino/>)

Douglas Brown, Wolfgang Christian, Robert M. Hanson. Tracker Video Analysis and Modeling Tool (Copyright © 2022) Windows Tracker download (<https://physlets.org/tracker>)

OzoEDU, Inc. (2022) Ozobot getting started (<https://ozobot.com/create/ozoblockly>)

# Abstracts

## SCIENCE CONNECT: GOOD INTERNATIONAL EXPERIENCE

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This project has been a very good experience for students, for teachers and for our school in general. It has been first time being involved in a Erasmus + projects, with added difficulty of Covid situation and pandemy. We have developed this Project exchanging experience with other European countries (Turkey, Romania, Italy, Greece, Portugal and Latvia), and it has been amazing. We have had the oportunity to live and know diferent countries, different cultures, obtaining new friends for the future. With this small video we have tried to recopilate a small summary with our experiences, participants, activities, cultural programmes, and of course the most important of the project: science. Science connect has been the tittle of a project which has recopilated great experiences in great countries, a personal and a profesional experience that we will never forget in the future.

**Keywords:** MOBILITY, SCIENCE, TECHNOLOGY



## FLOWERBUD APP

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O projeto FlowerBud App, desenvolvido por alunos do 12o ano no âmbito do projeto Erasmus + “Science Connect”, baseia-se na avaliação do nível de humidade de um solo, através de um sensor. A informação é transmitida ao microcontrolador Arduino que, através de uma ligação bluetooth com o telemóvel, envia os valores para processamento. A aplicação FlowerBud conclui se a informação avaliada respeita os parâmetros pré-definidos para cada planta pré-definidos na plantação. Caso os valores não estejam de acordo, o usuário receberá um aviso sob forma de notificação, indicando diferentes níveis de alerta para que a rega seja efetuada sem prejuízo da planta. Este projeto deverá então proporcionar uma plantação caseira eficiente, facilitando este mesmo processo. Com recurso a esta aplicação, pretende-se eliminar a idealização urbana de que cuidar de plantas é uma tarefa complexa, apelando para o agradável passatempo que a agricultura biológica pode assumir, associando a mais valia de consumir alimentos mais saudáveis e, essencialmente, contribuir para um ambiente mais sustentável no que define a nossa responsabilidade social e ambiental perante os Objetivos de Desenvolvimento Sustentável definidos para 2030 (nomeadamente os objetivos 12, “Produção e Consumo Sustentáveis”, e 15, “Proteger a Vida Terrestre”, da Agenda).

**Palavras-chave:** Agricultura Biológica, Aplicação, Arduino, Sustentabilidade

Our project FlowerBud App, developed by year 12 students in the framework of the Erasmus + "Science Connect" project, is based on the evaluation of the humidity level of a soil, through a sensor. The information is transmitted to the Arduino which, through a bluetooth connection with the mobile phone, sends the values for processing. Our FlowerBud application concludes if the evaluated information respects the pre-defined parameters for each plant. If they aren't meet, the user will receive a warning in the form of a notification, indicating different levels of alert so that irrigation can be carried out without harming the plant. This project should then provide an efficient home plantation, facilitating this very process. Using this application, we intend to eliminate the urban idealization that taking care of plants is a complex task, appealing to the pleasant pastime that organic farming can assume, associating the added value of consuming healthier food and, essentially, contributing to a more sustainable environment in what defines our social and environmental responsibility towards the Sustainable Development Goals defined for 2030 (namely goals 12 and 15 of the Agenda).

**Keywords:** Biological Agriculture, App, Arduino, Sustainability

## SOIL GRADER

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Com o objetivo de maior sustentabilidade e de hábitos alimentares mais saudáveis via consumo de alimentos plantados em casa, foi criado o Projeto Soil Grader, que consiste na criação de um dispositivo que mede a qualidade do solo onde se encontram as plantações do utilizador e que o informa (através de Bluetooth) se o solo estiver com qualidades desfavoráveis para as plantações. Este projeto foi desenvolvido por alunos do 12oano, no âmbito do Desenvolvimento e Autonomia Curricular (DAC). Para isso, este projeto visa a criação de um sistema com o arduíno que mede os valores de humidade e pH do solo, e transfere os dados por bluetooth para uma aplicação no telemóvel (criada em APP Inventor). Por fim, caso um desses valores passe para níveis não recomendados ou perigosos para a planta ou plantação onde os sensores se encontram, a aplicação envia uma notificação ao utilizador que o informará do sucedido, pedindo que este tome ação para reverter a situação.

**Palavras-chave:** Arduino, Jardinagem, Monitorização

With the aim of sustainability and of healthier eating habits, through consumption of home-made products, we have decided to create the Soil Grader Project, whose aim is what was previously mentioned, which means it aims to create a device that measures the soil quality of the user's plantations and that informs him (through Bluetooth) if the soil has any qualities harmful to the plants. This project was developed within the scope of DAC (Desenvolvimento e Autonomia Curricular which translates to Development and Curricular Autonomy). For this, our project is set on the construction of an Arduino system that measures the pH and humidity values of the soil, and transfers them to a cellphone application (built on MIT's APP Inventor). Afterwards, if any of the values reach a critical level to the plant or plantation, where the sensors reside, the APP will send a notification to the user, so that action can be taken to fix the situation.

**Keywords:** Arduino, Gardening, Monitoring

## INTERSECTION SIMULATION USING ARDUINO UNO AND OZOBOT BIT

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The main goal of our project is to combine Arduino UNO platform electronic capabilities and OZOBOT mechanical capabilities. The project aims are to show traffic simulation using a microcontroller, crosswalk and sidewalk layout with lines (for OZOBOT movement), traffic lights, HC-SR04 sensors (ultrasonic sensors) and a buzzer. Our team has worked out crosswalk and sidewalk layout on paper. Using FDM 3D printer, we have created small traffic lights and put LEDs in them. Our team believes that this project can improve safety of pedestrians near the road, using modern electronic components. The technologies used for this layout can be adopted in the similar situations in real life. Another case of usage is functions for disabled people, especially for blind people. The buzzer informs blind people about safe road crossing. OZOBOT begins to move slowly along a given trajectory, at the same time HC-SR04 sensor, which is connected to Arduino UNO, measures distance to OZOBOT. When the robot gets close enough and turns to cross the road, Arduino switches the traffic light from red to green and activates the buzzer. When OZOBOT finishes crossing the road, ultrasonic sensor on other side of the road (which is also connected to Arduino) turns traffic light to stoplight and switches off the buzzer. When OZOBOT approaches the ultrasonic sensor, it begins triggering: Arduino switches the traffic light to green and turns on the buzzer. After OZOBOT crossed the road, it keeps moving to sensor. When OZOBOT approaches on a close distance, process repeats. The project proceeds cyclically.

**Keywords:** traffic lights, pedestrians

## PEPPERONI

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A PEPPERONI é um instrumento que converte a energia mecânica associada às passadas humanas em energia elétrica, baseando-se no efeito piezoelétrico direto para realizar esse processo de transformação de energia. Uma face da plataforma encontra-se equipada com elementos piezoelétricos cerâmicos ligados entre si segundo uma associação mista e externamente a um microcontrolador Arduino e unidade de armazenamento de energia. O microcontrolador está conectado a um módulo Bluetooth que permite o envio de dados registados á distância, assim como a monitorização de cada unidade. A energia obtida pelo equipamento é utilizada para alimentar dispositivos como telemóveis, fontes de iluminação e outros mecanismos. Desta forma, esta proposta surge como uma alternativa, “limpa” e sustentável, aos meios energéticos atualmente utilizados para os mesmos fins, da mesma maneira que promove o desvinculo com fontes energéticas reconhecidamente nefastas.

**Palavras-chave:** Energia sustentável, Piezoelectricidade, Sustentabilidade

PEPPERONI is an instrument that converts mechanical energy associated with human steps into electrical energy, based on the direct piezoelectric effect to perform this process of energy transformation. A platform face is equipped with ceramic piezoelectric elements connected to each other through both parallel and series connections and externally to an Arduino microcontroller and energy storage unit. The microcontroller is connected to a Bluetooth module that allows the sending of remotely recorded data, as well as the monitorization of each unit. The energy obtained by the equipment is used to power devices such as mobile phones, lighting sources and other mechanisms. Thus, this proposal emerges as not only a "clean" and sustainable alternative to the energy resources currently used for the same purposes, but also that it promotes the detachment from energy sources that are admittedly harmful.

**Keywords:** Piezoelectricity, Sustainability, Sustainable energy

## ACQUIRING AND ANALYZING DATA FROM ARDUINO-BASED EXPERIMENTS

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For physics classes, laboratories have a special role, being an integral part of the study of this science. Unfortunately, the endowment with equipment is often not enough, so we are looking for alternatives that we can afford.. In this article we present an alternative using sensors and Arduino, as simple tools, for data collection and processing. The experiment consists of an electronic circuit for determination of the corresponding distance, position and time of moving objects, using an Arduino Uno, a servomotor and an ultrasonic sensor. We built a sonar to determine the three parameters, which can be transformed into a radar. Using Microsoft Data Streamer, an Add-in for Excel we streamed and recorded data into worksheets for later analysis. The data were represented graphically and processed. Although with limitations, determined by the technical characteristics of the sensors used, the method can be adapted to the study of different movements, replacing sensors with better ones..

**Keywords:** Arduino, Data Streamer, experimental data

## INTEGRATED STUDY OF PHYSICAL PHENOMENA - MODELING, 2D INTERACTIVE SIMULATION AND TRACKER VIDEO ANALYSIS

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Sciences study is not a priority for most of our students. One reason is that it is difficult to connect the real world with theoretical study. That is why we set out to find ways to attract students to this field, so as to allow them an easier understanding, based on creativity and imagination, for an inquiry-based learning approach. We have selected simple mechanical phenomena, for which students can create functional models, the movement of which can be analyzed using the Video Tracker analysis software. For a better understanding, we asked our students, for the same phenomena, to create interactive 2D models, using Algodoo, which provides direct data and graphics, and whose recordings were analyzed with Tracker. Students had the opportunity to choose the best way to study, from those proposed, depending on personal interests and skills. Applied in the Erasmus + Science Connect Project, the method proved useful, with a significant increase in students' interest in studying Sciences.

**Keywords:** video analysis, interactive simulation, functional mock-ups