The 6 Roboscientists projects

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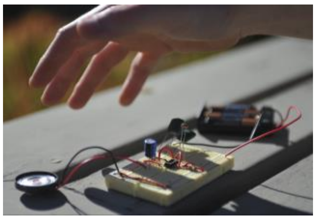
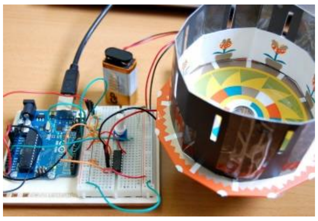
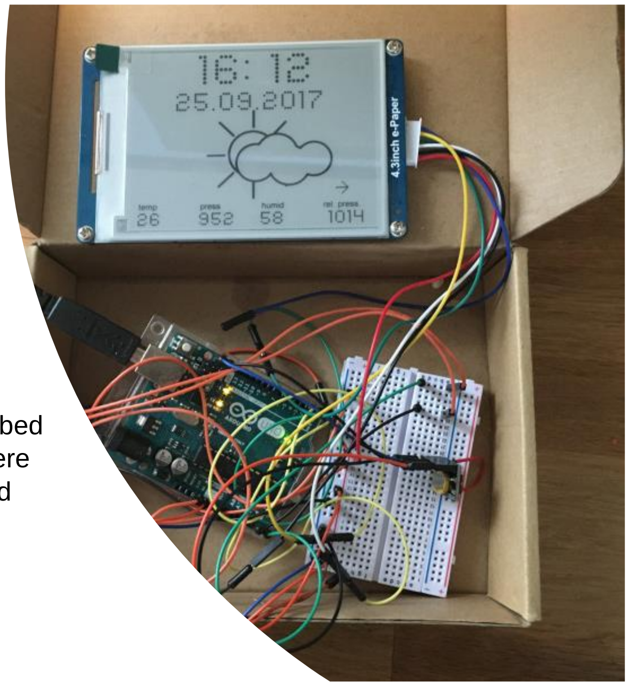
About this file

Below you can find the 6 projects towards robotic artefact construction that were selected by the Roboscientists partnership. The project partners reviewed several scenarios for projects and collaboratively decided which ones will be developed and implemented in the class. After the 1st review cycle the partnership selected 13 project scenarios which were further reviewed. Here you can see the list of the 13 project scenarios together with the learning objectives that they serve.







More precisely the 13 projects were put into a complexity map to further ease the final selection ensuring that the final selection will include projects that scale in difficulty. In addition, it was decided that each project will include several levels (where applicable) to further accommodate students' needs and interests. Ideas for extensions were also reported to widen the walls of the projects and offer space for new experimentations and expression of individual interest and initiative.

This process led to the 6 projects that are described below. For each project supporting resources were designed, tailored to each project challenges and needs.

The Lighthouse project

Project Scenario	The lighthouse that blinks both at a specific and/or different rates only at dark and/or according to the distance of the sailing ships
Description of levels	**Level 1:** Make the lighthouse blink/ Implementation of the blinking functionality **Level 2:** Make the lighthouse blink at different rates **only at dark** **Level 3:** Make the lighthouse blink at different rates **only at dark and according to the distance of the sailing ships** **Level 4: Exploring physics- capacitor**
Time/Duration	**2-6 hours** (depending on the level of complexity and the level of engagement in the construction/hand-crafting part)
Main technical functionalities	The lighthouse system consists of two sensors, an actuator and the MicroController Unit (MCU). The sensors detect changes of light brightness (night or day) and any object in the environment around them (analog and digital inputs of MCU), providing information for the MCU to react to. Actuator, on the other hand, provides an electrical response (digital output of MCU) according to the inputs provided by the sensors and processed by MCU. Specifically, for the lighthouse project: • The sensors are one (1) photoresistor and one (1) Ultrasonic transducer • The microcontroller unit (MCU) is the Arduino Uno board • The actuator is a Light-emitting diode (LED)
Hardware and materials needed	• cardboards, cups, recycled material and many different types of paper for making the structure • wooden sticks • wires and LEDs, photoresistors, resistors • Ultrasonic sensor (optional) • Arduino Uno board
Relevant subject areas	**ICT** (programming, connecting physical and digital world) **Physics** (electrical circuit making, understanding what intensity of light is, periodic polling, frequency of blinking, what a blinking pattern is, capacity/capacitor)

	Technology/ History (issues related to continuity and change of lighthouses over time, technological and scientific developments over long period, Maritime History) **Arts** (in the case of Van Gogh's Starry Night */ artistic approaches i.e. abstract designs etc...)
Software	Snap4Arduino (recommended) & other block- based programming environments
Useful links	**The context** https://en.wikipedia.org/wiki/History_of_lighthouses http://ponceinlet.org/images/content/what_is_a_lighthouse.pdf https://www.scienceabc.com/pure-sciences/how-the-light-from-lighthouses-can-be-seen-miles-away.html http://www.oldest.org/structures/lighthouse/ **For demonstration in the class** https://youtu.be/DbCVSNB_ccs **Crafting- Ideas for inspiration:** https://youtu.be/avseDPB5oPU
Extensions	**Optional:** Extent the project scenario i.e. a city of lights, block of flats in the night, Van Gogh' s 'Starry Night' and more!

The Phototropism/sunflower project

Project Scenario	The orientation of plants according to the location of light
Description of levels	**Level 1:** The sunflower identifies the lighter source and moves towards it (multiple solutions of different levels of difficulty)
Time/Duration	3-5 hours
Main technical functionalities	The sunflower system consists of two sensors, an actuator and the MicroController Unit (MCU). The sensors detect changes of light brightness (left-center-right) in the environment around them (analog inputs of MCU), providing information for the MCU to react to. Actuator, on the other hand, provides an electrical pulse response (digital output of MCU with Pulse Width Modulation - PWM) according to the inputs provided by the sensors and processed by MCU. Specifically, for the sunflower project: • The sensors are two (2) photoresistors • The microcontroller unit (MCU) is the Arduino Uno board • The actuator is an angle servo motor
Materials needed	• cardboards, recycled material and many different types of paper for making the flower • wooden sticks, metal wire, buttons, … • photoresistors, resistors, wires, breadboards • angle servo motors • Arduino Uno units
Relevant subject areas	**ICT** (programming, connecting physical and digital world through the use and synchronization of multiple sensors) **Physics** (electrical circuit making, understanding what a motor is and how it works, controlling motion) **Biology** (the phenomenon of Phototropism) **Environmental Education** (environmental factors that might cause a plant to move or face a different direction) **Maths** (variables, analogue reading transformation) **Arts** (Van Gogh's sunflowers)
Software	Snap4Arduino (recommended) & other block based programming environments
Useful links	https://nature.berkeley.edu/news/2016/08/sunflowers-move-clock https://www.thoughtco.com/phototropism-419215 https://living.thebump.com/phototropism-sunflowers-8545.html
Extensions	Connection to Arts (Van Gogh's sunflowers)

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The smart light project

Project Scenario	A light that turns on when movement is detected. Context: As cities grow, the challenges they pose environmental, economic, and social grow with them. But cities are hubs of diversity and innovation: they can also become the source of solutions.
Description of levels	Level **1**: a smart light that turns on only when movement is detected Level **2**: a smart light that turns on only in dark and when movement is detected
Time/duration	**3-5 hours** (depending on the level of complexity and the level of engagement in the construction/hand-crafting part)
Materials/Hardware needed	• cardboards, recycled material and many different types of paper for making the artefacts, straws, plastic or paper cups, wooden sticks • foil, glue • Arduino Uno board, wires, resistors (220 Ohms, 1K Ohms), LED, PIR sensor, photoresistor
Relevant subject areas	• Environmental Education & Sustainable Education (environmental policies, environmental friendly actions and decisions, innovative solutions, citizenship and active engagement) • Language and Literature (brainstorm, discuss and answer various questions develop reports, present, i.e. how can we protect the environment? How can we become active citizens? What do we mean by active citizenship and engagement?) • ICT (programming, connecting physical and digital world through the use and synchronization of multiple sensors) • Physics (movement, sensors, electrical circuit making, understanding what a PIR sensor is and how it works) • Maths (variables, comparisons)
Software	Snap4Arduino, ArduinoIDE
Useful links (for inspiration)	https://www.youtube.com/watch?v=FxaTDvs34mM https://www.youtube.com/watch?v=6Fdrr_1guok https://www.youtube.com/watch?v=Zn8MMA2-Opw https://www.youtube.com/watch?v=2mwVC08looc

	https://www.youtube.com/watch?v=ZGjsQpJ7Z_Y
Optional Extensions	1) Collaborative project: a smart highway (the students place all the smart light in the corresponding mock up) 2) The light intensity adjusts to environmental conditions (i.e. fog)

The theremin project

Project Scenario	Creation of an electronic musical instrument controlled without physical contact by the performer. Sounds are produced by the movements of performer's hand around the instrument. The Theremin is an electronic musical instrument controlled without physical contact by the performer. It is named after its inventor, Leon Theremin, who patented the device in 1928.
Description of levels	**Level 1:** 1 hand operated Theremin: sounds are produced using a piezo buzzer and one hand. *In the simple form Theremin can be controlled with one hand.* *The closer we place our hand to the photoresistor, the lower the pitch (low-pitched). As we move our hand up, the value of the pitch increases (high-pitched).* **Level 2:** 2 hand operated Theremin supported with a photoresistor and an ultrasonic sensor: notes/sounds and beat can change. **Level 3**: 2 hand operated Theremin supported with a photoresistor and an ultrasonic sensor: sounds can be composed and imported by the students.
Time/Duration	4-8 hours (depending on the level of complexity and the level of engagement in the construction/hand-crafting part)
Main technical functionalitie s	The Theremin system consists of two sensors, an actuator and the MicroController Unit (MCU). The sensors detect changes of light brightness (night or day) and any object in the environment around them (analog and digital inputs of MCU), providing information for the MCU to react to. Actuator, on the other hand, provides an electrical response as sound (digital output of MCU) according to the inputs provided by the sensors and processed by MCU. **Specifically, for the lighthouse project:** • The sensors are one (1) photoresistor and/or one (1) Ultrasonic transducer and • The microcontroller unit (MCU) is the Arduino Uno board • The actuator is a buzzer

Materials needed	• photoresistor sensor • ultrasonic sensor • buzzer/ piezo • cardboards, paper cups, glue, recycled material and many different types of paper for making a cover box for the theremin instrument • Breadboard, jumpers, resistors (100 Ohms, 1K Ohms) • Arduino Uno
Relevant subject areas	**ICT** (programming, connecting physical and digital world through the use of sensors, loops, conditional statements, boolean logic) **Physics** (electrical circuit making, understanding what a beat is, volume, sound waves) **Maths** (use of variables, translating music into mathematics,) **Arts** (music: learning to create music through altering tone and pitch, electronic musical instrument, various musical instruments, description, characteristics, emotions, uses) **History** (facts, the story of the development of the theremin project, important dates and names, inventors, the era it represents) **Language and Literature** (brainstorm, discuss and answer various questions develop reports, present, i.e. the use of the theremin project now and then)
Software	Snap4Arduino, Arduino IDE
Useful links	About Theremin: https://www.techexplorist.com/theremin-musical-instrument-never-touch-play/4027/ Light Theremin: https://www.youtube.com/watch?v=57S3dylfw3I https://learn.adafruit.com/adafruit-arduino-lesson-10-making-sounds/pseudo-theramin Ultrasonic Theremin: https://www.instructables.com/id/Ultrasonic-Theremin/
Optional Extensions	Stick for visually impaired people Parking system

The DIY automobile project

Project Scenario	The students construct their own automobile that can move forwards and backwards, turn at specific degrees, detects obstacles and being controlled remotely
Main technical functionalities	• Constructing the DIY automobile model taking into account the dimensions of the core elements (motors, sensors, panels etc) • Constructing the electrical circuit using the Shield • Movement/ motor synchronization • Detection of obstacles – use of the ultrasound sensor • Programming with block-based environments and IDE • Remote control- setting up the Bluetooth
Materials needed	Full list: https://www.dropbox.com/s/2jew97hzddmg04l/MaterialList_DIY_toberevised.xlsx?dl=0
Duration	The crafting process is demanding. It is estimated that at least three 3-hour sessions are needed.
Relevant subject areas	**ICT** (programming, control of flow, algorithmic thinking, controlling sensors, remote control) **Science** (solar power, perceptual aliasing) **Physics** (electrical circuit making, understanding what a motor is and how it works, controlling motion, ultrasound waves, ultrasound sensitivity, talking about solutions for energy autonomy, pros and cons of solar parnel, ensuring stability of the model (crafting)) **Maths** (variables, analogue reading transformation, geometry, measurements **Arts** (aesthetics, drawings, getting to know artists)
Software	ap4Arduino / Snmblock Arduino IDE
Useful links	Examples: https://www.youtube.com/watch?v=x6MKmQSq9CE&feature=youtu.be
Levels and Extensions	**Level 1**: A DIY automobile that moves forwards, left, right, backwards. Both solar banks and batteries will be tested . **Level 2:** A DIY automobile that performs specific movements based on students' interests/preferences (i.e. moving on different angles and/or geometrical shapes (like square, triangle). * *the shapes will be sketched on paper or with tape on the floor.* **Level 3**: A DIY automobile that detects and avoids obstacles. **Level 4** Controlling remotely the DIY automobile

The weather station project

Project Scenario	The students will be encouraged to create their own weather station for measuring pressure, temperature, humidity and dust concentration.
Description of levels	**Level 1**: Pressure, temperature and humidity measurements **Level 2**: Measurement of dust concentration **Level 3:** Visualization of the measurements **Level 4:** Interpretation of collected data
Time/Duration	**Level 1:** about 45 minutes **Level 2:** about 45-60 minutes **Level 3:** about 15-30 minutes **Level 4:** about 45 minutes or as a homework **Total:** 3-4 lessons (45 minutes)
Main technical functionalities	• Communication with advanced sensors by I2C bus, • Reading the values from analog sensor • Visualisation of measurements • Estimation of statistical and systematic uncertainties
Materials needed	In case of **Arduino UNO** board: • Arduino UNO board • Grove Base Shield • Grove Barometer Sensor (BME280) • 2x Grove wires • Dust sensor GP2Y1010AU0F with wire • Grove-LCD RGB Backlight In case of **Arduino Mega 2560** board: • Arduino Mega 2560 board • Grove Mega Shield • Grove Barometer Sensor (BME280) - • 2x Grove wires • Dust sensor GP2Y1010AU0F with wire • Grove-LCD RGB Backlight
Relevant subject areas	**ICT** (programming, control of flow, algorithmic thinking, controlling sensors, bus communication) **Physics** (measuring temperature, humidity, pressure and dust sensor) **Geography** (weather changing, weather parameters) **Technology** (bus communication) **Maths** (variables, analogue reading transformation)
Software	Arduino IDE
Useful links	n.a
Optional Extensions	n.a

ROBOSCIENTISTS PROJECT

Motivating secondary school students towards STEM careers through robotic artefact making

Erasmus+ KA2 2018-1PL01-KA201-051129

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Declaration

This report has been prepared in the context of the ROBOSCIENTISTS project. Where other published and unpublished source materials have been used, these have been acknowledged.

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