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Code The Future
2019-1-TR01-KA229-074007

PLANNING AN EDUCATIONAL ROBOTICS SYSTEM

INTRODUCTION

Planning an Educational Robotics System is a way to provide students with a creative and original experience.
Team collaboration is an aspect of primary importance. Educational projects, should indeed, be based on brainstorming, which denotes discussing about all theoretical, practical and developing features, starting from the expected outcome.
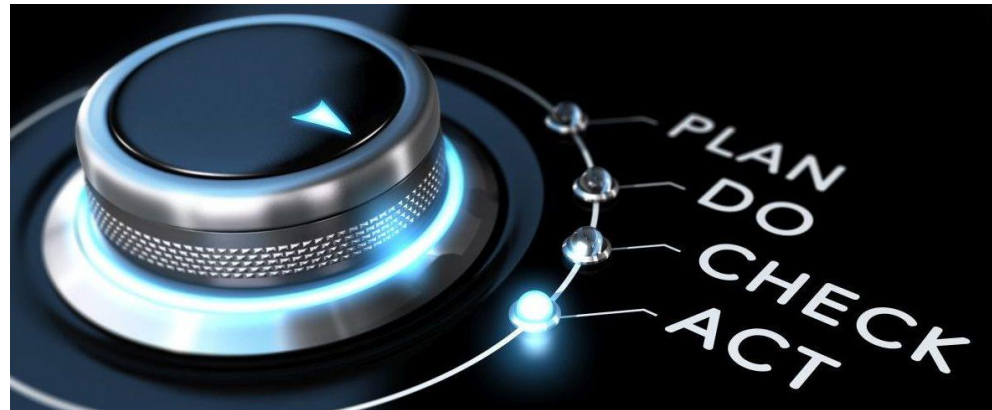
To finalize this kind of activity, students need to be endowed with creativity, endurance and a strong knowledge of Electronics, Informatics and other scientific subjects.
The teacher's main task, actually, is to guide students through the theoretical-practical path, removing all obstacles in order to let them acquire new notions, even complex ones, in an easy and funny way.

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Aims

➢ contributing to human and professional growth in a significant way;
➢ creating a creative, tangible, shareable and reusable product;
➢ improving the ability to co-design and to work in a team;
➢ expanding and diversifying the use of digital technologies for the learning-teaching process;
➢ developing students' digital and technical skills.

Design proposal

The project's methodology about a robotic system should rely on the analysis of the following points:

i. Identifying the notions students want to acquire/be provided with;
ii. In accordance with the previous point, detecting which disciplines can be involved;
iii. Arranging a scale of the levels of difficulty of the theoretical and practical activities that the students will have to carry out;
iv. In agreement with the previous points, planning a specific robotic system;
v. Scheduling regular brainstorming activities together with the students to evaluate the state of art of the project to hypothesize likely changes and improvements.

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A practical example- **The creation of a Radio Controlled Robotic Arm**

"Creative robotics" is an activity mainly aimed at inclusiveness. The description, therefore, fits perfectly with the previous assumption according to which students are encouraged to learn or further develop their competences, being free to express themselves according to their abilities, their potentialities and their interests.

The specific skills to be enhanced concern Software Production, Electronics, and notions about Data Transmission through antennas.

Step 1- **Identifying subjects**

-Information Technology, Electronics and Telecommunications

From an educational point of view, it is thus possible to strengthen and/or to acquire specific notions related to the following topics:

- C++ programming, thanks to software development through Arduino IDE;
- Electronics, thanks to the use of electronic components, wirings and measurements;
- Telecommunications, thanks to the use of TX/RX LoRa for Arduino and its antenna features.

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Step 2- **Arranging a coherent plan of activities to be carried out under a decreasing order of difficulty**:

    a. proposal of hardware systems or software codes functional to the project

    b. realization of hardware systems or software codes

    c. proposal of hardware/software changes, if necessary

    d. implementation of any hardware/software changes

    e. electronic components wiring

    f. mechanical components assembling

Step 3- **According to what established in the previous points, defining the specific tools:**

- Lego Mindstorms EV3 kit components
- Arduino UNO R3 board with EV3 Arm Control Shield
- LoRa 433 MHz RX Radio Control Receiver
- LoRa 433 MHz TX Transmitter and a second Arduino UNO R3 Board for the remote control
- A breadboard with connection cables for Arduino and Lego
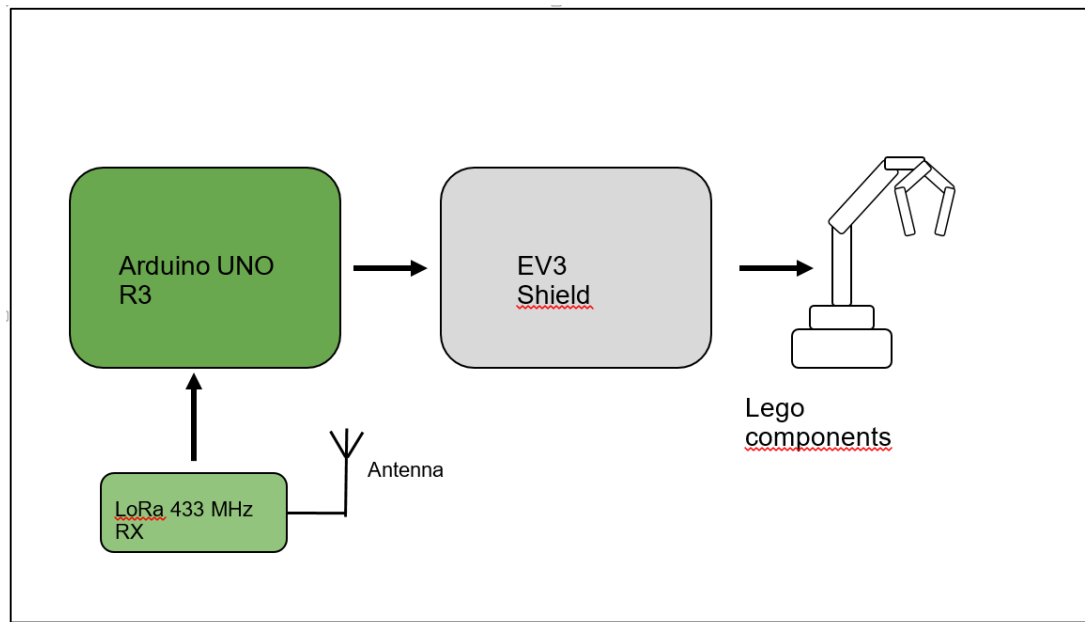- Measurement instruments

Step 4- **Foreseeing on a regular basis, approximately every three meetings, a brainstorming activity in order to have a recap and develop new likely ideas and rearrangements**.
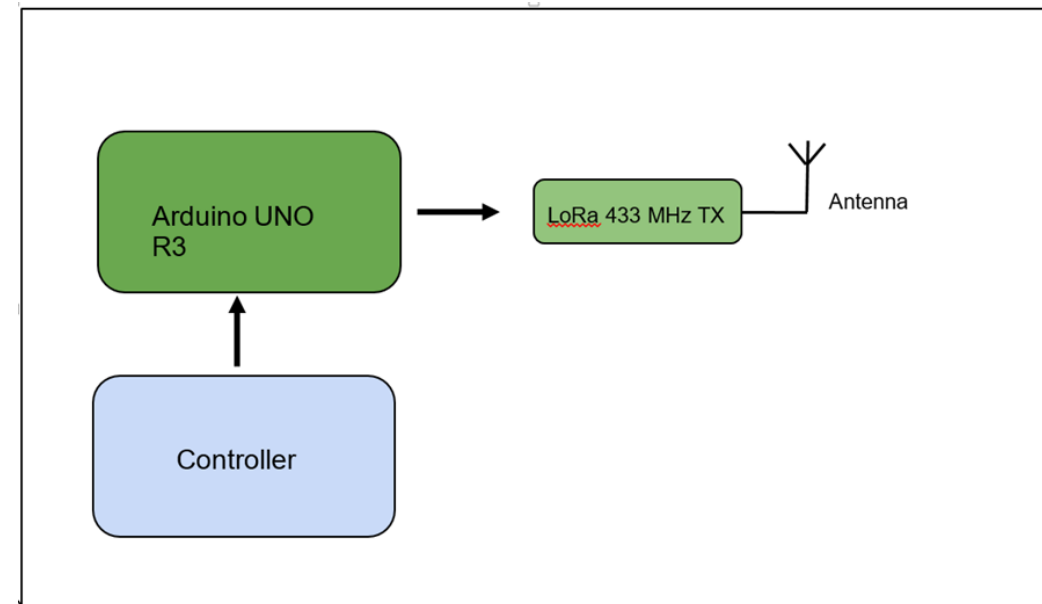
Functional Diagram of Components

Robotic Arm

Radio Controller

Robotic Arm diagram: Arduino UNO R3 → EV3 Shield → Lego components; LoRa 433 MHz RX with Antenna connected to Arduino UNO R3

Radio Controller diagram: Controller → Arduino UNO R3 → LoRa 433 MHz TX with Antenna

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Practical implementation

The robotic arm has been built using a Lego project kit available online. It is the famous EV3 Mindstorms set.

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However, the programmable block kit has been replaced and customized with an Arduino UNO R3 Board, interfaced via an EV3 Shield produced by Mindsensors This adapter permits to expand the interconnection capabilities of Arduino boards so that it is possible to program Lego sensors and actuators by using Arduino development environment and C++ language.
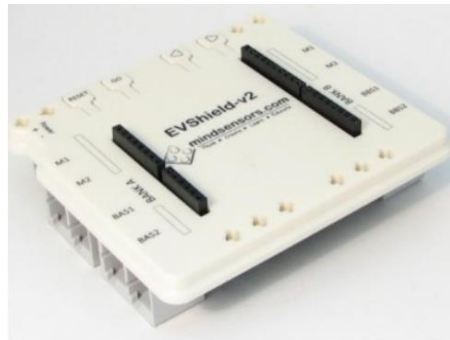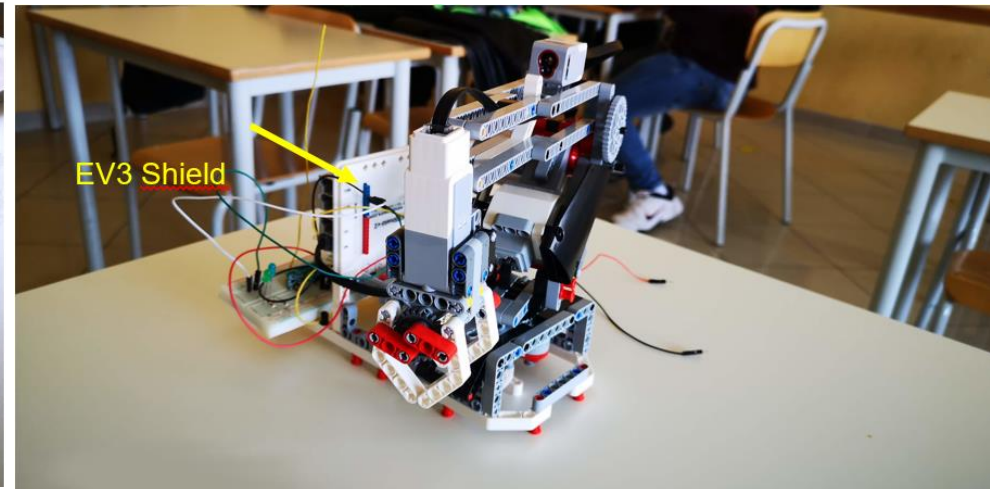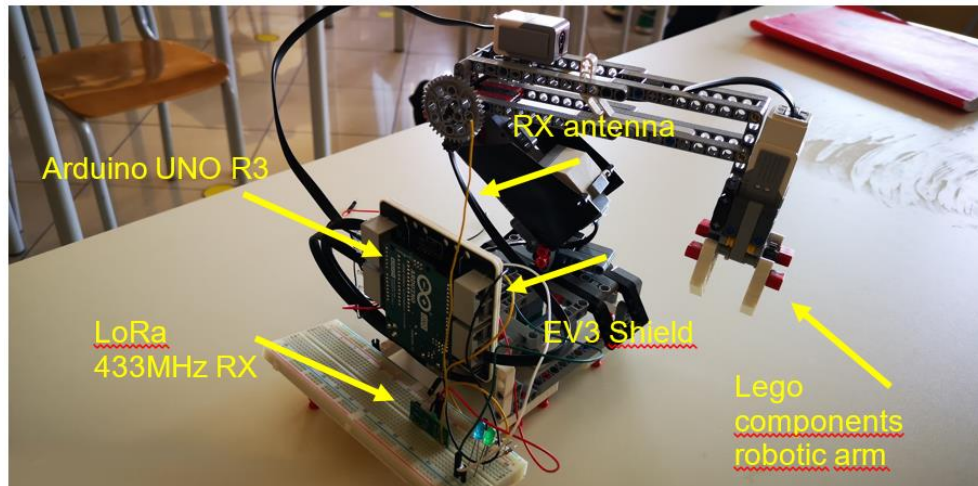

To make the project even more interesting, the Robotic Arm has been equipped with a 433 MHz LoRa receiver programmable with Arduino board

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The final output

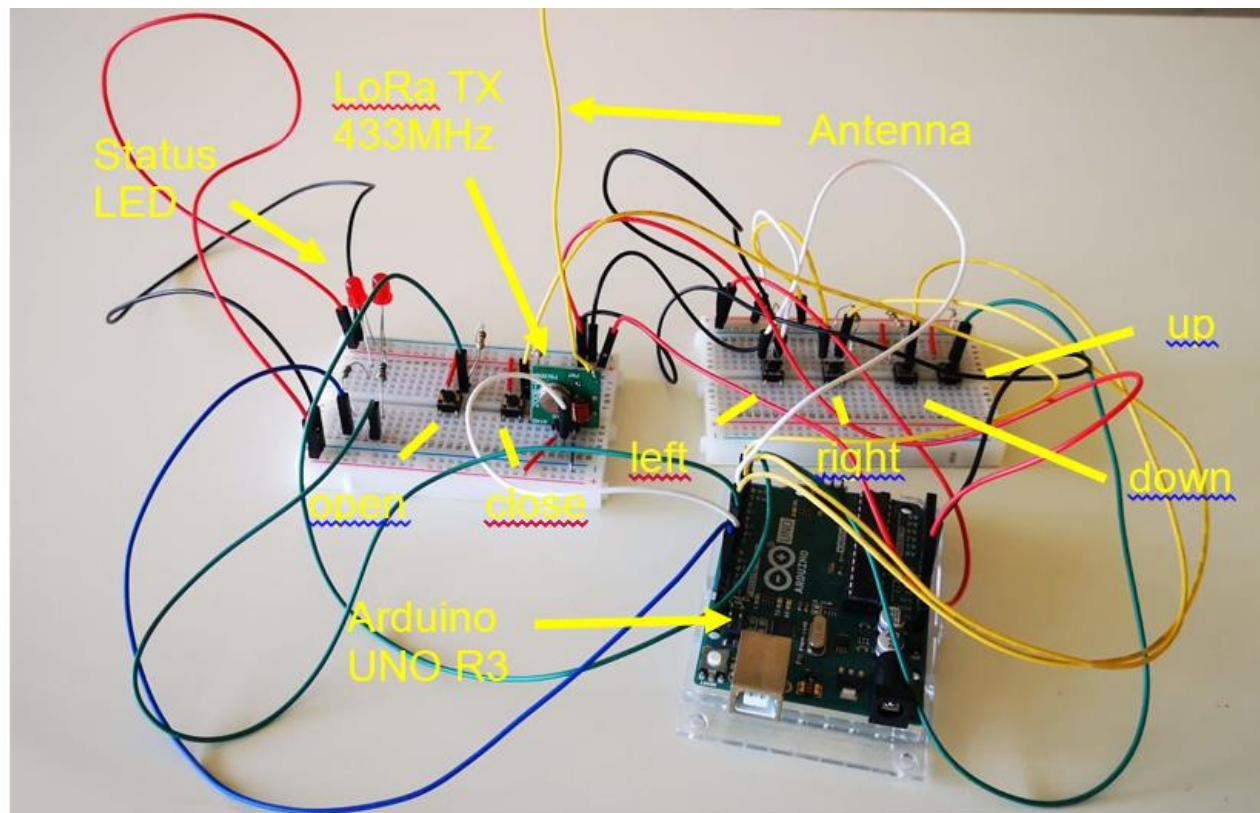Arduino UNO R3
RX antenna
LoRa 433MHz RX
EV3 Shield
Lego components robotic arm

EV3 Shield

Instructions are given through a remote control made with an Arduino UNO R3 Board and a 433 MHz LoRa Transmitter.

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The remote control prototype

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Skills developed according to the different subjects

Telecommunications and Electronics

- *Ohm's Law*

Knowing how to measure voltages and currents
Knowing how to calculate the absorbed power

- *Electronics components*

Recognizing resistors basing on measurements or color code
Knowing how to connect a LED diode with the right polarity
Knowing how to use a breadboard for making prototypes
Knowing how to apply the concept of a pull-down resistor to a button
Knowing how to perform devices troubleshoting

- *Antenna*

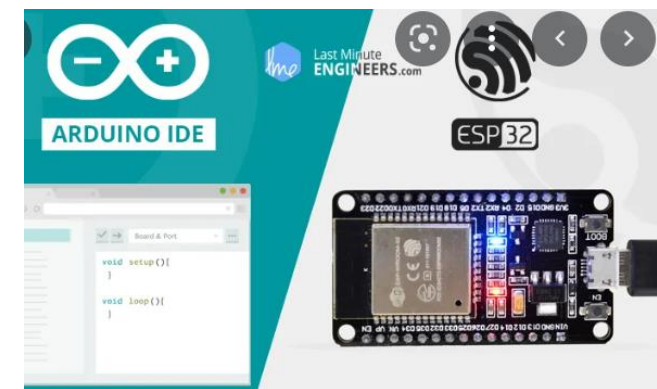Knowing how to calculate the dimensions of an antenna according to the wavelength

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Information Technology

- *Development and debugging environment*

Knowing how to use Arduino IDE for software development

Knowing how to use the serial monitor and the tools for program debugging

- *Libraries*

Knowing how to find and install the needed libraries for software development

- *Instructions*

Knowing how to use Arduino's own commands

Knowing how to use iterative statements and conditional statements in a robotic system

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