ROBOESL PROJECT

ROBOTICS-BASED LEARNING INTERVENTIONS FOR PREVENTING SCHOOL FAILURE AND EARLY SCHOOL LEAVING

Erasmus+ 2015-1-IT02-KA201-015141

Output 1: Curricula for 10 exemplary interdisciplinary robotics projects

Curriculum 8: To be or not to be

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[1] EDUMOTIVA stands for 'European Lab for Educational Technology

Declaration

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 Where other published and unpublished source materials have been used, these have been acknowledged.

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Abstract

This document contains the description of the Curriculum n. 8, entitled ‘To be or not to be’ which is part of the Intellectual Output 1 (Curricula for 10 exemplary interdisciplinary robotics projects) developed and tested in teacher training courses within the context of the ERASMUS+ ROBOESL project. It could be involving to organize a theatrical performance mixing humans and robots. This Curriculum provides some suggestions to program the robot for this purpose.

Chapter 1: **Short description and scenario (O1.1)**

(source: The Telegraph)

How to put the robot on the stage.

1.1 The scenario

This is an open curriculum: several suggestions are provided to give the robot an active role as character of a theatrical play, either as a protagonist or a singer or interlocutor. It is up to the teacher to decide how to organize a suitable theatrical scenario and the complexity of the role of the robot. We know that we can ask the students to prepare specific audio clips to be uploaded unto the robot so that it can reproduce them, we know how to make the robot move and dance, how to enlighten the brick colored led, how to use sensors to make the robot react to specific stimuli. In this curriculum we provide some suggestion to solve the main problem which is to synchronize the robot actions so that the theatrical action evolve in a convincing way. We will use time, coded information, and also messages sent by another brick which could be kept in a hand by one of the other human actors or by an external director. Therefore, instead of providing a full solution, we show here a simple example for each of the usable techniques.

1.2 Connections with subjects

1. Arts and literature: no limit to the number of links suggestible in the subjects of theatre, literature, music and poetry.

2. Informatics: message passing technique to synchronize the activities of two independent entities.

Chapter 2: **Pedagogical objectives (O1.2)**

2.1 General objectives

- To provide students with a stepwise approach for a step by step acquisition of technical skills in using robotic technologies (hardware and software) building on existing knowledge and skills.
- To offer the robotics benefits for all children, especially those at risk of school failure or early school leaving.
- To engage students in STEM related subjects through interaction with the robotics technologies.
- To support self-directed action allowing learners to learn independently.
- To engage students in robotic constructions and problem solving through an interdisciplinary scenario that reflects aspects of real-life problems and situations.
- To align the robotics project to learners' needs and interests through tasks that derive from the initial activity but introduce new levels of complexity and difficulty.

2.2 Specific objectives

More specifically, upon successful implementation of the activities described in this curriculum students will achieve the following objectives:

- Understand the need to carefully synchronize the robot's actions with humans' (or possibly other robots') actions
- Learn how to produce audio clips using the tool built-in in the EV3-G software
- Learn more in detail how to reproduce sounds and clips
- Learn how to use colors and brick's buttons as command codes
- Understand better the options of the Switch and the Wait block
- Learn how to connect bricks through the Bluetooth wireless connection and how to use this connection to send/receive messages
- Learn how to synchronize through messages

Chapter 3: **Suggestions for learning methodologies (O1.3)**

The students are encouraged to work in groups through a special worksheet designed as a reference and supporting tool.. The teacher acts as scaffold and facilitator of the learning process. S/he provides discrete feedback when necessary without revealing solutions encouraging students to overcome emerging problems and difficulties.

The activity starts with the creation of a theatrical scenario by the students. The students are invited to elaborate on their own scenario in groups and to form a general methodology for realizing the scenario. This activity differs from the ones already introduced as this time the students are not only called to create the mock-up, that is the environment into which the robot will operate based on the scenario of the activity but also to get involved in craft-making and to creatively decorate the robot as an actor on the stage according to their scenario. The students are then encouraged to reflect upon possible ways of making the robot to play its role.

The teacher will support the students during this process and will make the necessary contributions when needed respecting students' scenario. These contributions might include: how to make their robot to play sounds and audio clips using the tool built-in in the EV3-G software; how to exploit further options for using the `Switch` and the `Wait` blocks; how to use the brick buttons to control the robot's behaviour; how to connect two robots through the Bluetooth wireless connection and how to use this connection to send/receive messages between two robots in order to synchronize robot's behavior with the messaging block.

In each case students are encouraged to practically apply these new tools in order to synchronize the robot's behaviour and to develop further their scenario.

The teacher moves students to playfully explore a number of alternative combinations for synchronization of theatrical movements and other actions. The students should free their imagination and regulate the theatrical behavior of the robot! Some role play might be encouraged with students acting on the stage the same role they envision for their robots to play.

A. The role of the students

Students first discuss a scenario through a free dialogue in their group and after that they devise an action plan to realise it. They work in groups following their ideas and the discrete feedback they receive from the teacher. Students may extend their initial scenario devising further stories to play with. First, they find solutions making their own experimentations. Then they are supported to find additional solutions and realise further ideas. The final creations of the groups are presented in the class, are discussed and evaluated with students reflecting with critical mind on their work, expressing their views and recording their experiences in a diary or questionnaire.

B. The role of the teacher

The teacher in this constructivist learning framework acts as an organizer, coordinator and facilitator of learning for students. S/he organizes the learning environment, raises the task for making robotics theatre through a worksheet, introduces software tools when necessary for students' work, discreetly helps where and when necessary, encourages students to work with creativity, imagination and independence and finally organizes the presentation and evaluation of the activity in the plenary of the class.

Chapter 4: **Technical guidelines (O1.4)**

4.1 Building instructions

The usual *tribot* structure is suitable also for the purposes of this curriculum, but according to the acting role of the robot, for example depending on the type of character it will interpret (an animal, a human with special attributes, a famous hero or well known public character), the teacher could ask the students to build more complex and dressed structure. The sensors to be connected depend on the type of stimuli are foreseen. At this point the students should have enough familiarity with the whole spectrum of sensors to decide new positions and new features for them.

4.2 Illustrative solution

Let's begin with a simple predefined time schedule: all the actions of the robot are performed on a time-based sequence, imposed by a sequence of `Wait` commands. In fig. 1 we show the reproduction of four different audio elements, three notes of different pitch and duration with different time separation, and a final audio file. You can use a structure like this, setting the schedule, for example, on the basis of the dialogue between the robot and a human actor in order to give the impression that the robot is enough 'intelligent' to interact properly with the human.

Figure 1. Time schedule of audio reproductions

Another possibility to synchronize the robot behavior is to use color codes. Preparing some small pieces of paper with rectangles filled of colors that are easily distinguished by the color sensor (see fig. 2 and 3), it is possible to associate each color with an action by means of the color variant of the `Switch` command. Notice, as already previously explain, that you can reproduce music and execute motions concurrently. A good suggestion is to use the *no color* option as the null default option to do nothing when no color is provided by the user (fig. 4) or, alternatively, to wait for a color in the set of fig. 2 and then applying the color code to the `Switch` command (fig. 4).

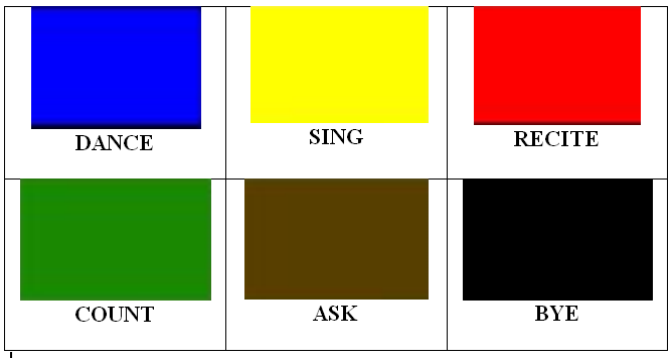


Figure 2. Color codes to prepare

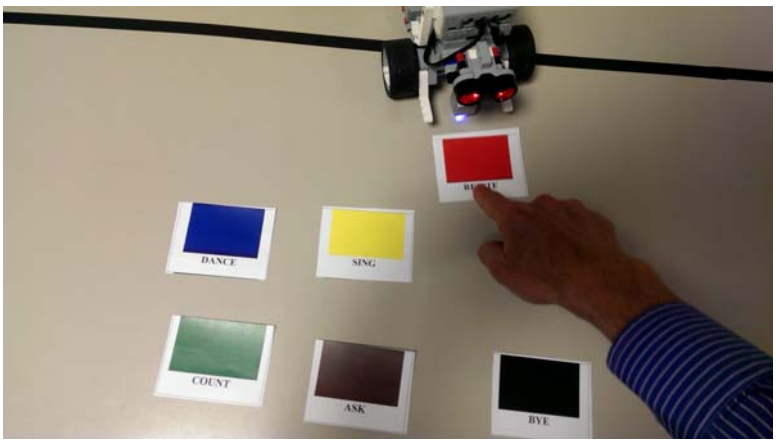
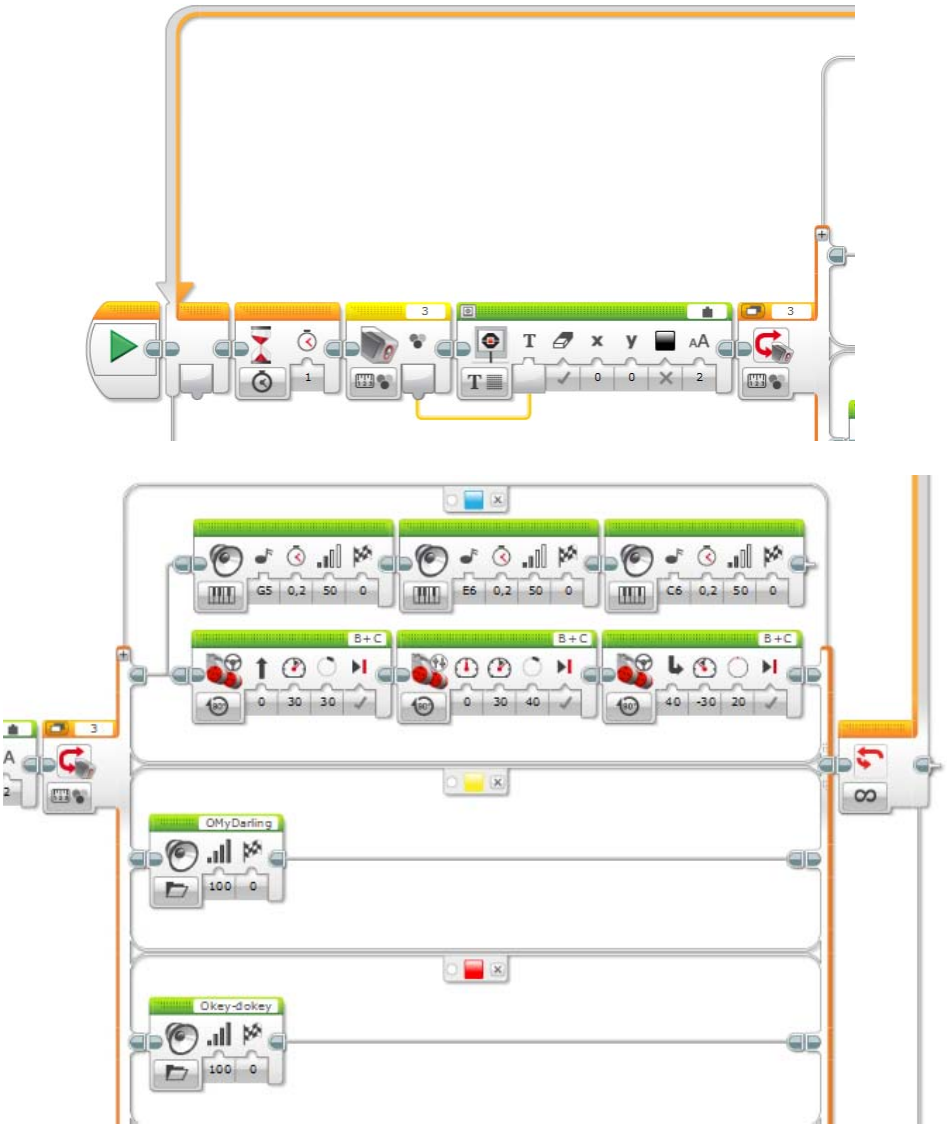


Figure 3. How to 'send' commands



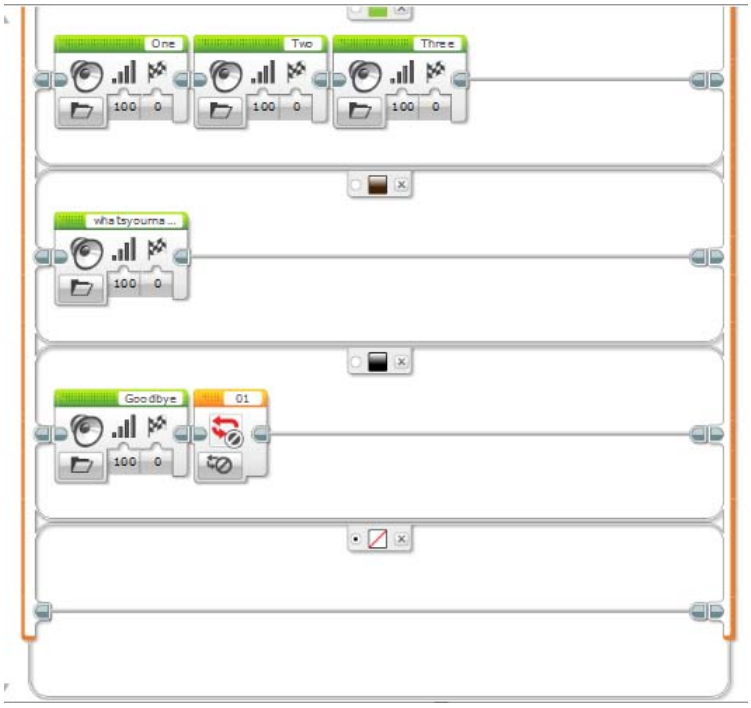


Figure 4. Synchronization based on colors

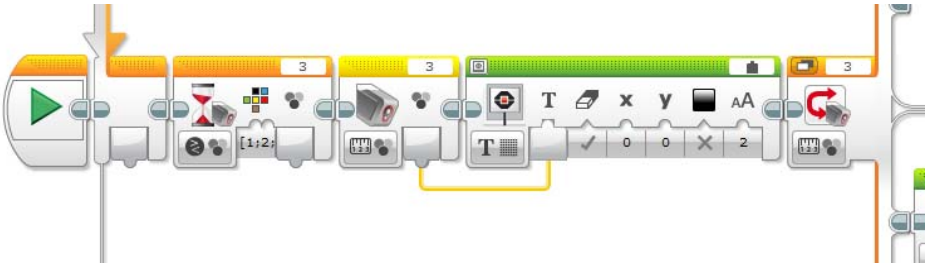


Figure 5. Alternative for waiting one of the command color

Another simple possibility is to use the brick buttons to ask the robot to execute one of a small set of actions. The major limitation is the total number of buttons usable (5), which reaches some more units if you use also push buttons connecting them to the brick input ports. In fig. 6 we show 5 actions, one for each button, plus the 0 default option (0 = none, 1=left, 2=centre, 3 = right, 4 = up, 5 = down).

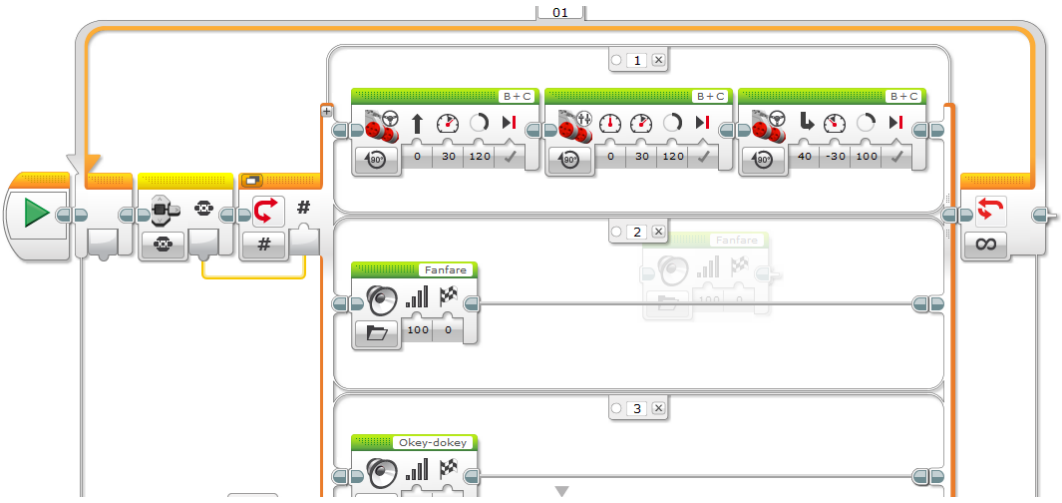


Figure 6. Synchronization based on the brick buttons

The most effective way to synchronize actions for the 'acting' robot is to send messages from another robot through a Bluetooth connection. For exploiting this feature, let us assume for simplicity that you have already made the peering of the two robots and the connection is already established. To do this, follow the user's guide and provide different brick names to the two robots in order to recognize each other.

For the controlling robot we can use the very general program of fig. 7 which sends a message every time you press one brick button on this robot: usefully, the button code is sent to the other robot through a message (see the `Messaging` block, for simplicity the message name is always the same) and also displayed. The brick led flashes to confirm the sending and then it 'reset' the sent command sending a '0'. `EXEC` is the name of the receiving robot.

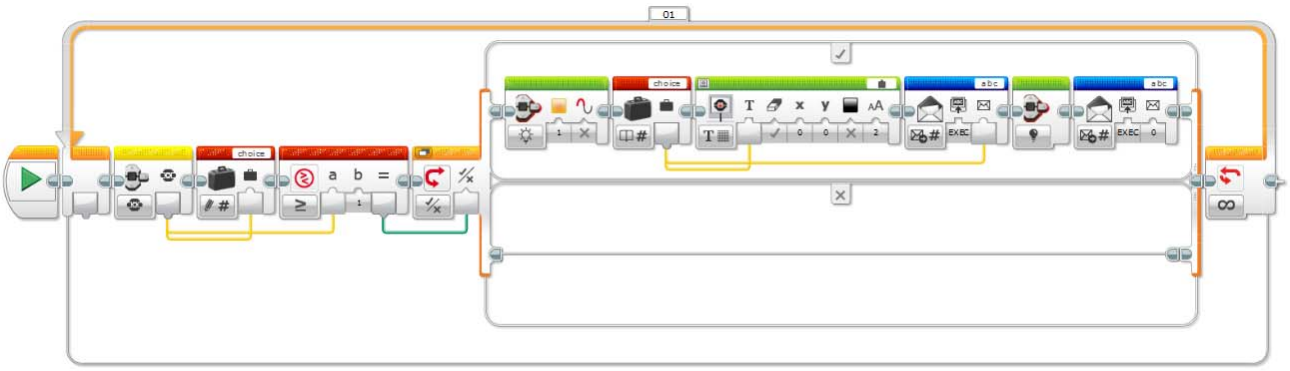


Figure 7. Synchronization based on transmitting a message

To adapt the example of fig. 6 to this form of remote control, you can program the receiving robot as in fig. 8. The transition from a '0' message to one containing the button code is detected by the `Wait` block with the *Message variation* option. Resetting with 0, which is made by the transmitting robots, assures that such a transition is correctly detected.

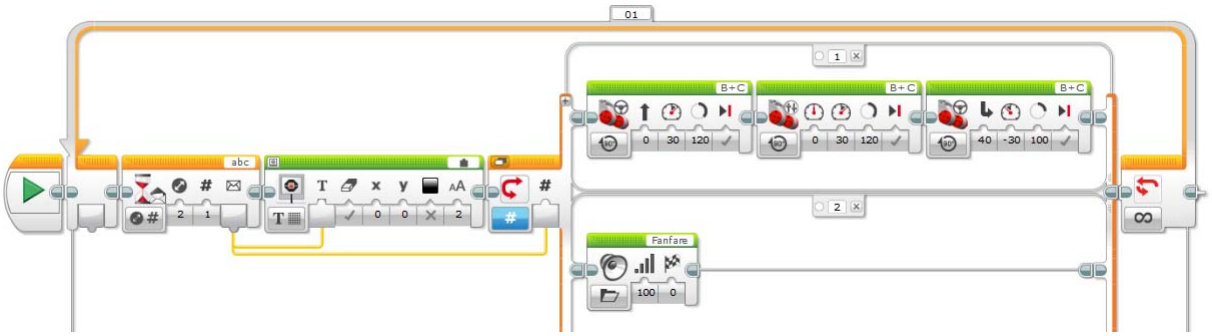


Figure 8. The synchronized robot

The last example we present goes back to a sequence of actions singularly synchronized by the pressure of any brick button on the controlling robot (you can easily use a push button instead, if preferable): in this way you can simulate a dialogue between the controlling human and the controlled robot which seems a convincing acting on the stage.

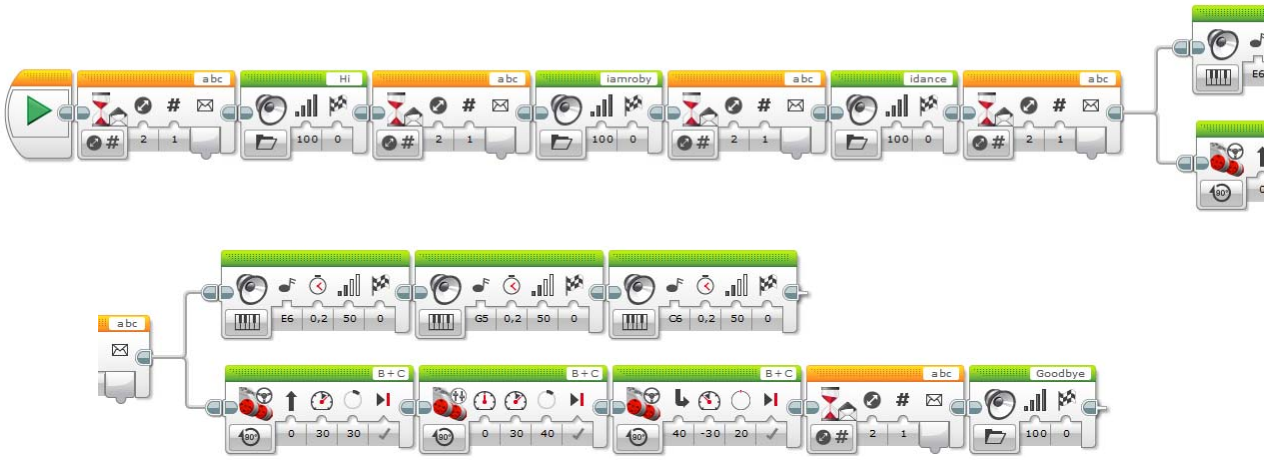


Figure 9. A simulated dialogue

4.3 Implementation suggestions

Fantasy and the preparation of a storyboard can render this curriculum particularly funny and rewarding. The teacher and the students can choice the most suitable way to synchronize the robot's actions considering the scenario, the complexity of the play, and other details of this kind. The collaboration of the student team in preparing all the aspects of this curriculum is crucial for its fully success.

Chapter 5: **Evaluation tools (O1.5)**

Use the rubric below to evaluate your students' achievement in each specific objective of this curriculum.

Name of student (or group of students): ……

upon completion of the activities described in this curriculum students achieved the following objectives	**Evaluation score** **0 = not attempted** **1 = attempted without success** **2 = partial success** **3 = completed with teacher's help** **4 = completed without teacher's help**
Created a scenario for a theatrical play	
Creatively decorated the robot for the needs of the theatrical scenario they created	
Created a mock up and the environment within which the robot-actor would operate based on the scenario	
A clear comprehension of the problem of synchronize robot's actions	
Produced and manipulated sounds and audio clips	
Used the Sound block with all its options	
Used color and button codes in order to ask a robot to perform a specific action	
Used the different options of the Switch block	
Used the different options of the Wait block	
Connected two robots through Bluetooth	
Made synchronization using messages between robots	
Collaborated effectively to design and realize the play	