

An introduction to Robotics with LEGO® MINDSTORMS (XV)

EV3: what's new?

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The EV3 has already been on the market for some time. First the educational version appeared in early August, a launch that wasn't exempt of problems; before the end of August a problem was detected in part of the batteries that had been distributed that made them unusable and at the beginning of October distribution was suspended until March 2014. A setback for the schools and FLL teams that wanted to migrate to the new system.

September brought the Retail version, finally also available in Spanish, something that had been demanded for quite some time and that will make it easier to distribute the product in Spain and Latin America. The EV3 Retail version comes with 5 base models and 12 additional creations from members of the LEGO® MINDSTORMS Community Program.

The EV3 has a number of improvements that go beyond a better controller, more power, a 4th motor post and a memory capacity that will put all the trouble the NXT generated in the past. Let's see some of them.

Projects

While the NXT file system was based on files, the EV3 system is based on projects. This means that different versions of the program, the notes you keep, the images and videos... are all saved in a single file.



But in addition to making it easy to keep your project well-organised, this new system allows you to share it directly from EV3-G and the LEGO MINDSTORMS website. The only thing you need is a LEGO ID

Connecting several EV3 by USB

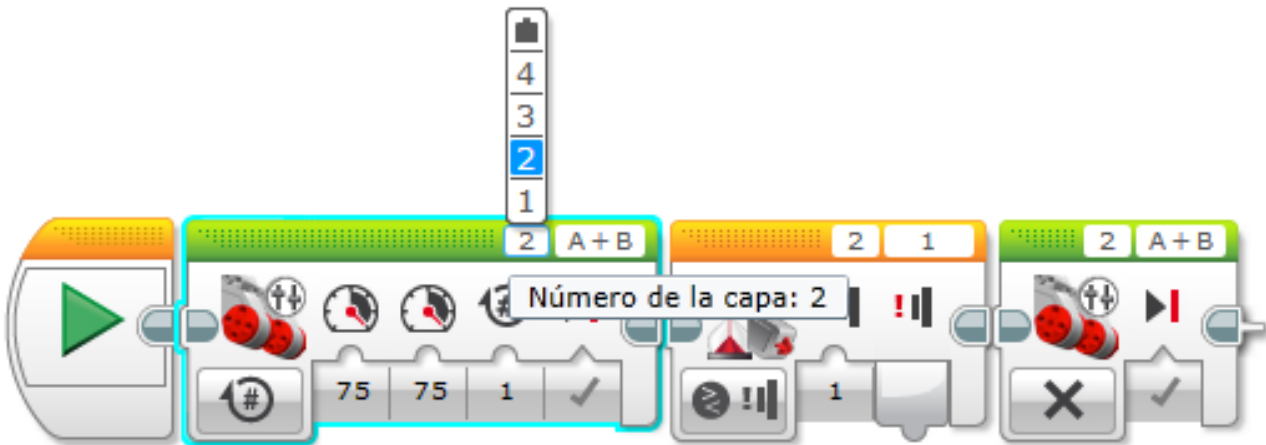
LEGO MINDSTORMS EV3 allows you to connect several EV3 bricks together and control motors and sensors connected to the different bricks from one of them. LEGO MINDSTORMS NXT already allowed two NXT bricks to be connected using one of the 4 sensor ports, but it was relatively complicated to do and not doable for everybody.

Now connecting and programming between 2 and 4 EV3 bricks connected by USB is easy by means of daisy Chaining. For example, if you connect two EV3s by Daisy Chaining, you can control up to 8 motors and 8 sensors from a single program that you need to download to the first EV3.

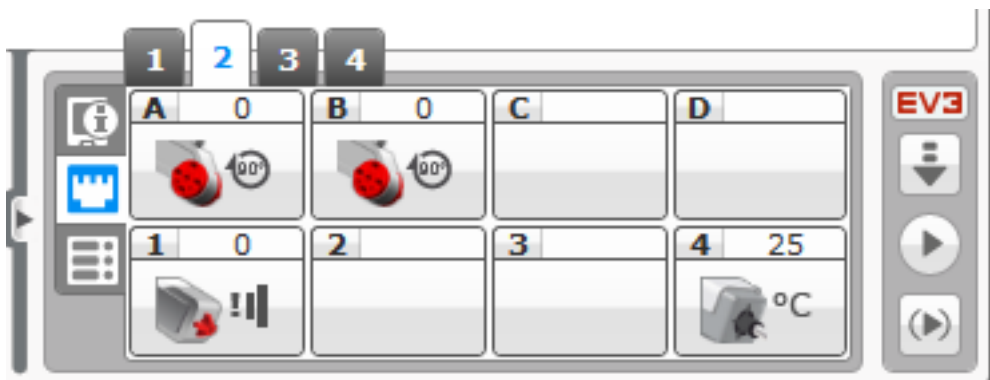
In order to do this you need to select Daisy Chaining on the properties page of the project.



This does not change the way you program compared to programming a single EV3, except for the added difficulty of controlling so many motors and sensors.

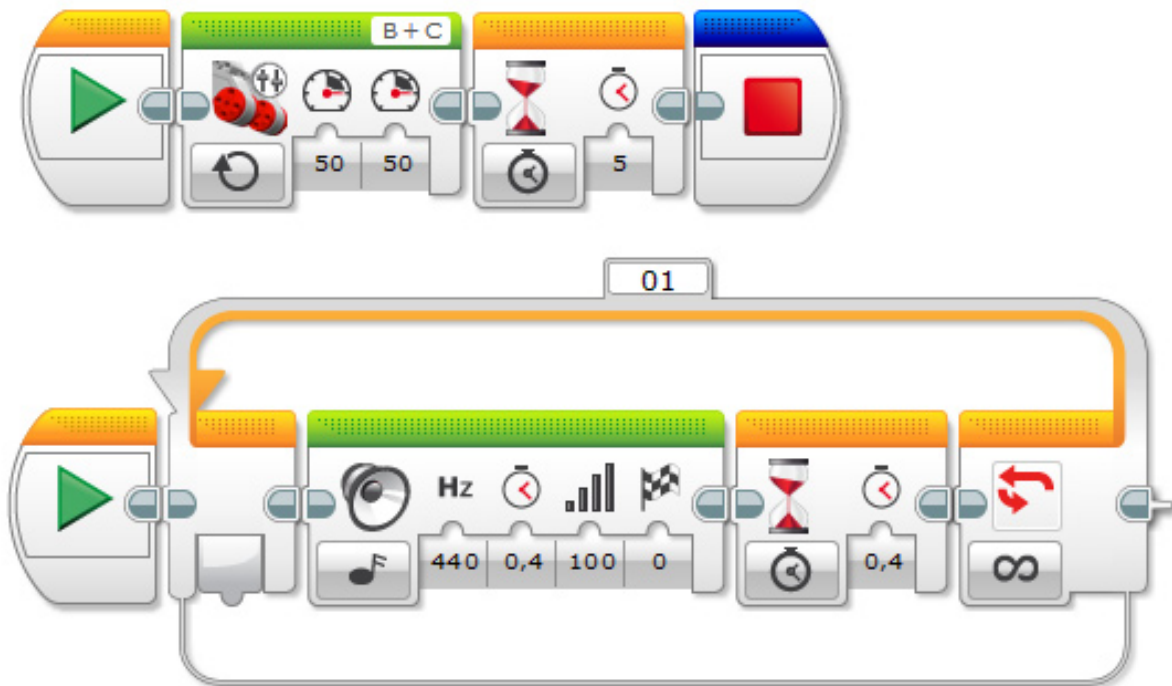


The motor and sensor blocks will allow you to select to which of the EV3s they are connected. In the image, motors A and B of the second EV3 will move until the touch sensor connected to port 1 on the second EV3 detect an input. On the hardware page the motors and sensors connected to the EV3s are shown on separate tabs.



Several sequences in one program

EV3-G allows you to create several sequences that can be executed simultaneously in a single program. All you have to do is add new start blocks to the program to create new sequences, so upon running the program they will be executed at the same time.

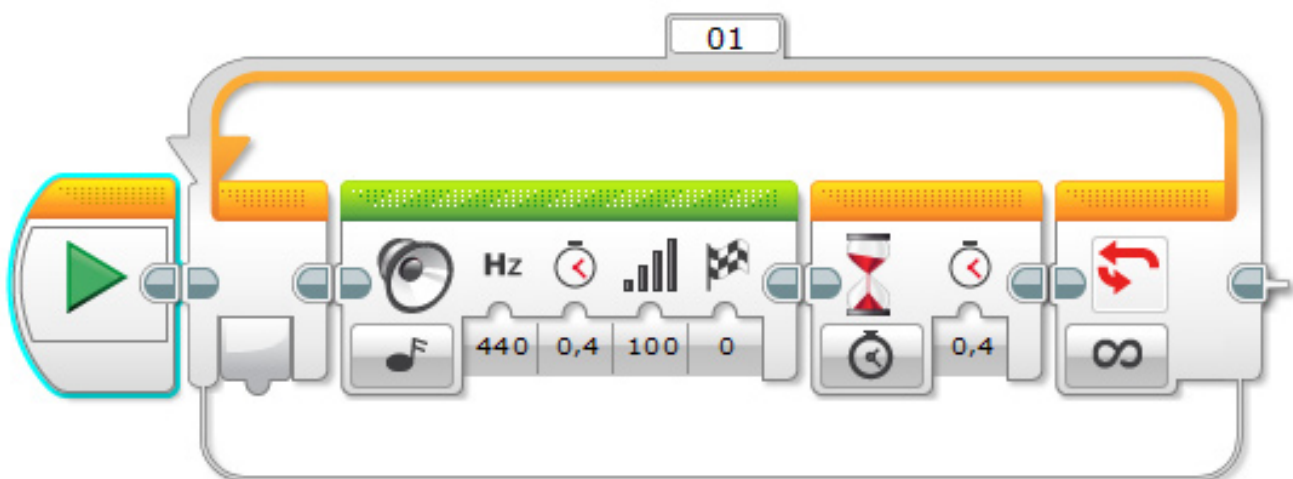


The start block can be found with the flow control blocks (orange) and it is more than a simple representation of the start of the program. If you connect the EV3 and click on the green triangle in one of these blocks the sequence connected to that particular block will be executed. This is very useful for checking the different parts of the program, as even if you have several sequences only the one connected to the start block you click on will be executed.

You can control the termination of a program from one of the sequences, as can be seen in the previous image. The Stop block is in the Advanced block tab and it will stop all the sequences in a program at the same time.

Visualizing program execution

EV3-G allows you to know which block is being executed at each moment in a similar way to how this is done in LabVIEW, the software it is based on. If you run a program with the robot connected to the computer (by USB, Bluetooth or Wi-Fi), the program will show which block(s) are being executed by animating them. The following screen capture was taken while the Sound block was being executed; you can see the angled lines at the top of the block that indicate this.



Wi-Fi connection

The EV3 can communicate via USB and Bluetooth, but also via Wi-Fi. This isn't the most recommendable method since it causes a higher energy demand from the battery, but in some cases it can be very useful.

At first it is a little disconcerting, because if you connect that adapter you have at home most likely it will not be recognised. The reason why to this date you can only use the Netgear WNA1100 adapter is that the Linux system that is installed on the EV3 only has drivers for that particular adapter. Although that is only the case if you use the official firmware, as with LeJOS it is also possible to use the smaller Edimax EX-7811UN. In time other adapters may become usable.

But... what can you do with a Wi-Fi connection on the EV3? I imagine that in time the options will multiply, but for now, with the Education version of the EV3-G software I have found the following options:

- transferring programs from the computer to the EV3
- monitoring sensors connected to the EV3 remotely, using the data collection system.

The first of the applications isn't very recommendable, unless you want to remotely start a program on the EV3. Otherwise the drain on the batteries that is associated with the use of Wi-Fi doesn't justify the exercise.

The second does appear to be interesting. One example could be a weather station that records changes in temperature, wind speed and pressure (when HiTechnic makes the programming block for its pressure sensor available). If the EV3 is connected to a Wi-Fi network you will be able to read the sensors remotely.

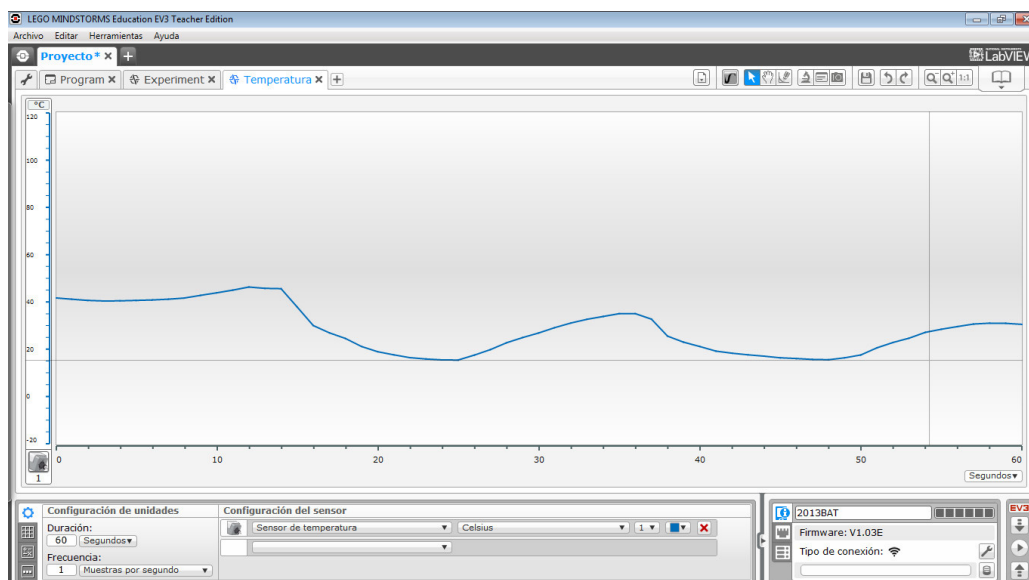
How to do it?

First you will need to configure the wireless connection for which you need to follow these steps:

- 1- Connect the adaptor to the EV3 and activate it under Settings > Wi-Fi on the EV3.
- 2- Connect to the desired Wi-Fi network from Connections, if the network is protected you will have to introduce the network key, after which a symbol will appear in the bottom left corner of the EV3 screen representing Wi-Fi active and another to its right indicating connection.
- 3- To connect the EV3-G software to the EV3 via Wi-Fi the connection must be configured from EV3-G. To this end, after connecting the EV3 to the computer with the USB cable you will need to open Tools > Wireless Setup and then Connect to the desired network. If the desired network doesn't appear, simply click on Add and find it in order to connect. After connecting via Wi-Fi you can disconnect the USB cable.

Once you are connected you can create a new experiment, establish the duration and frequency of the recording of data and run it.

If you just want to monitor without saving the data, clicking the Oscilloscope button you can see the real-time readings.



In the image you can see the result of recording the temperature during 60 seconds taking one reading every second. A glass with cold water was used to quickly drop the temperature, and the sensor was rubbed to increase it.

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