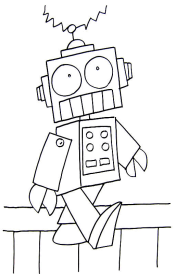


NXTSpaceApps Documentation

(Setup Guide & Educational Activities proposal)

Inventory

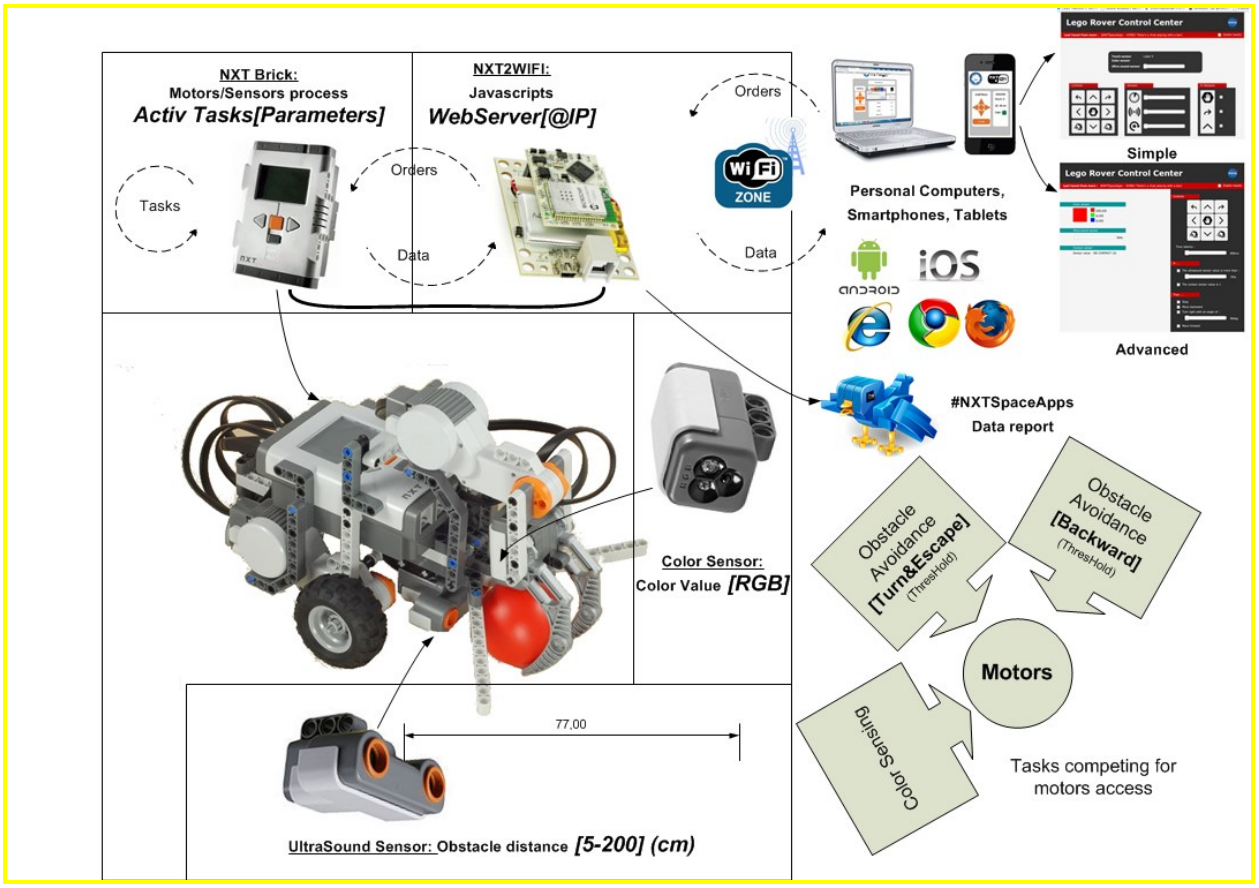
You need per robot:

- 1 NXT kit (8527 1.0 retail, 8547 2.0 retail, 9797 educational),

- 1 NXT2WIFI

- 1 Computer (with at least one free usb2.0 port), in order to :
    - Update the firmware (if necessary) and activate the NXT2WIFI,
    - Download the Webserver files into the NXT2WIFI,
    - Download the enhanced firmware (if necessary) into the NXT Brick
    - Download the NXT program.

How it works



The NXT Brick deals with sensor and actuators and real time tasks.

The NXT2WIFI has a microcontroller able to run a webserver. This webserver act as a link between the user and the NXT Brick.

Setting up the Robot

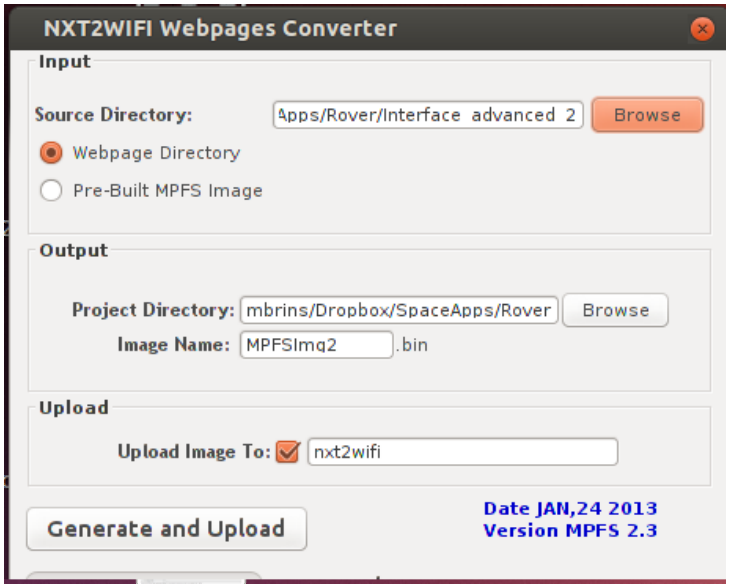
NXT2WIFI setup:

Read The Friendly Manual, if necessary, update the firmware and activate the sensor. You should get the “NXT2WIFI activated successfully!” message. This needs to be done once - the first time.

Webserver setup:

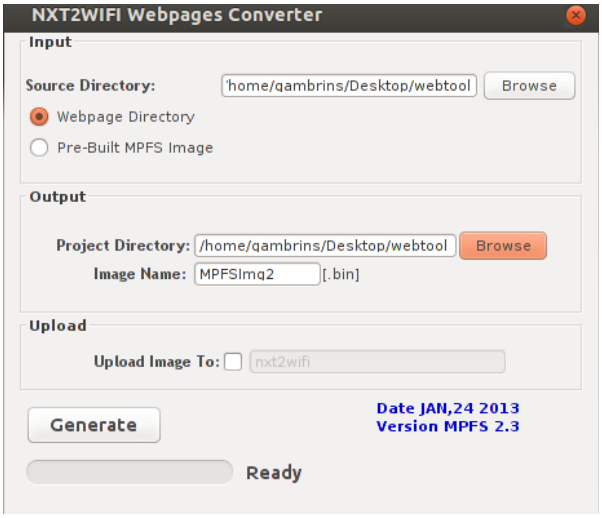
Download the **Webpages Converter Tool** on the NXT2WiFi website**,** and use the deflated folder **WEBPAGES** to transfer the files into the NXT2WIFI webserver. This has to be done each time you update the webserver files, when the version changes.

If you want to install an interface from sources :



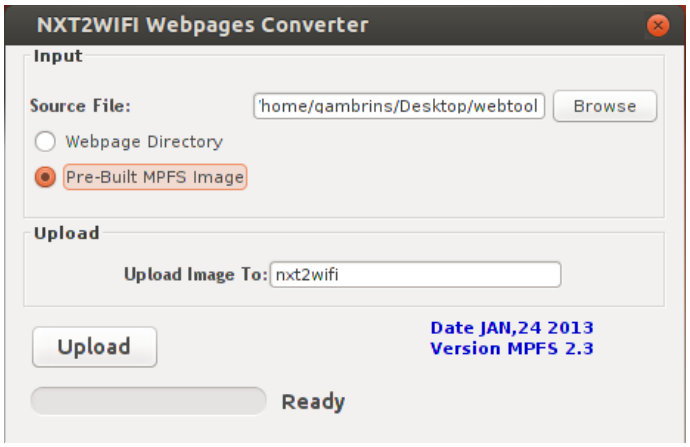
- In the input Source Directory, choose the folder WEBPAGES.
- Don’t care about the *OutPut* block
- Be sure that the *Upload Image To NXT2wifi* checkbox is activated
- Then click on *Generate and Upload* button

If you developed an interface and you want to send the binary file to a distant user :



- Repeat the first step
- Choose an ouput directory and an name for the image on the output block
- Uncheck “Upload Image To:”
- Then click on the *Generate* button

If you received a binary file and you want to install it on your rover :



- Choose : *Pre-Build MPFS Image*
- Check *Upload Image To : NXT2wifi*
- Then click on *Generate and Upload*

NXT brick setup:

If you have had to activate the NXT2WIFI previously, you already have done the necessary “enhanced” **firmware** download! It only has to be done once - the first time. This “new” firmware is retro-compatible with the genuine LEGO graphical language NXT-G, so no need to flash the firmware again and again.

NXT program download:

Use bricxcc you have already installed, to open **NXTPROGRAM** folder, put your **own values of the settings** and compile the program, then **download it** to the NXT Brick. It only has to be done each time you update the NXTprograms files, at version changes. Then run it directly on the NXT Brick. It should connect and display his own @IP.

LEGO Rover building:

Can be part of the educational activities, as children need to move and play to develop fine motor skills and, in turn, develop the areas of the brain that affect movement and co-ordination.

Direct Interaction with the Rover

Connect a mobile phone, a tablet or a computer to the @IP, let the webserver load the default page, and you’re in!

Educational activities

As LEGO and NASA promote STEM discovery, to promote logical thinking and fine motor skills, as well as spatial insight and imagination, we propose some pedagogical activities around NASA Mars Rovers, with the LEGO Rover NXTSpaceApps as physical support.

If enough time is allowed, children can build up the Rover from LEGO pieces (1/2 hour), and download the program into the brick (another 1/2 hour).

1. A teacher demonstrates a Mars rover teleoperation, highlighting the difficulties: lag, no emergency stop button, possibility of getting stuck... (1/4 hour)
2. After this demonstration, the teacher could divide the Class into small groups, and ask them to imagine and resolve a problem. They would then write a report describing the experiment, their own experience, and the solution proposed. (1/2 hour problem definition, 1/4 hour of experiments + 3/4 hour report writing (possible teamworks after school?) per group.
3. A classroom presentation is possible, dealing with all topics concerning Mars rovers, missions history or achievements. The group could present its report conclusions and share its ideas to solve the problem too! (1/4 hour per group).

WorkShop sheet example - *The annotation and answer suggestions in italic should be removed before giving this sheet to children.*

Objectives of this workshop :
The main purpose of this workshop is to figure out what are the issues about driving a rover mission on a faraway planet like the Curiosity mission on Mars. To do that you will use a Lego Rover which can simulate different aspects of this kind of mission. This sheet is intended to guide you but you can make your own experiments with the rover for a better understanding.

I - Theoretical part

In this part, you will have to try to answer some questions. There are no bad answers, the goal is to imagine that you are designing the rover before the mission and trying to think about all the things you will need because once the rocket will be launched, it will be too late to modify your rover!

I.1 How can you communicate with your rover during the mission?

Probably not with a wire. Waves would be better

I.2 The communication delay from Earth to Mars is 12.5min. If you ask Curiosity to send you a picture of Mars. How many time do you have to wait until you can see the picture?

*2*12.5 min= 25 min*

I.3 The speed of Curiosity is 90 Inches per minute. If you tell your rover to stop, what is the distance the rover will do before really stopping?

*90*12.5=1125 Inches= 93 feet 9 inches*

I.4 If the rover get stuck, is it possible for it to go back in the right track?

I.5 How can the rover detect obstacles?

Sensors

or

I.5 What kind of sensors can help the rover to detect obstacle

(etc. The number of questions and the technical level depends on what is the age and the skills of the children)

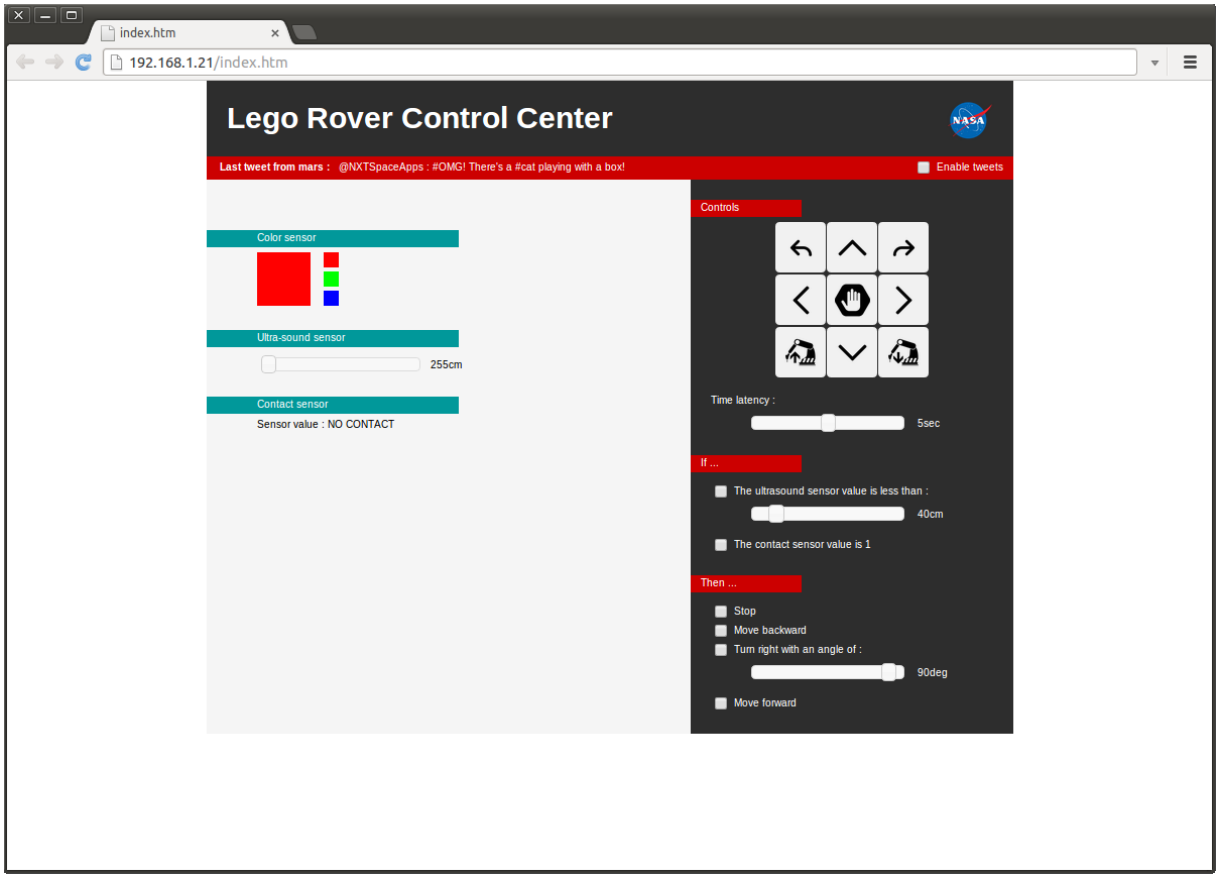
II - Practical part

Tools : - A Lego Rover
- A computer to control the rover

II.1 Look at the rover. Can you see the sensors? The motors? The control card?*(the Lego Brick)* The user-machine communication tool? *(nxt2wifi)*

II.2 Ask your teacher the address of the control interface and connect into it using the web browser

You should see this interface :



You can try to use it with the remote controler on the top right of the screen.
At this point, there is no latency and the rover cannot detect obstacles

II.2 Set a time latency of 3 seconds

Draw a mark on the floor and try to stop the nearest as possible of this point.
Note what happens: *Is it easy? What kind of issues did you encountered?*
Note what happens if you give another command before the execution of the first command

II.3 Remove time latency, check the "Then... Stop" checkbox and try the effects of the different sensors in the block "If..."

What kind of data gives you the ultra-sound sensor?
a distance

Move the rover towards a wall or an obstacle and stop at a distance of one meter. What do you read in the ultra-sound sensor? How does it work?
We read 100cm. This is the distance between the sensor and the wall.
The ultrasound sensors works with an echo, like bats. The furthest is the obstacle, the weaker is the echo signal, so the sensor may not detect the obstacle.

Try to press the contact sensor. What is the value given by it?
A boolean, a 0 or a 1, a True or a False...

What seems to be the best way to detect an obstacle?
When the contact sensor is activated, the rover may have already crashed...

If you set a 3 seconds latency and a 10cm obstacle detection. What is the distance between the rover and the obstacle?
It is the same as without latency because the latency occurs between the rover and the user, not between the sensors and the rover

II.4 MEDIUM MODE : Build a kind of track with some obstacles and try to reach a target with a 5s latency and "if 5cm then stop"

Note your remarks
When the rover stops we need to wait 5s before he starts to move again. It would be great if it could go around the obstacles by itself during this time.

II.4 EXPERT MODE : Build a kind of track with some obstacles and try to reach a target with a 10s latency and "if 20cm then stop"

Note the remarks.