NXT2WIFI

By Daniele Benedettelli

WHY ANOTHER WIFI SENSOR FOR NXT

In 2006, at the University of Siena, I developed a team of mobile robots team using the good old LEGO® MINDSTORMS RCX, in order to test the performance of a control law for collective motion (http://robotics.benedettelli.com/publications.htm).
http://www.youtube.com/watch?v=S2aAZBS0Rp0

The RCX was a good choice for research purposes because of its low cost, and the LEGO building system flexibility. The control law was implemented in a centralized supervisor software that detected the robots position on the ground using a ceiling mounted webcam and sending speed commands to the robots using the LEGO Infrared tower (do you remember it?). There were no servomotors at that time, so I had to implement a speed controller on the RCX using rotation sensors on the wheels and BrickOS replacement firmware. The main problem during the experiments was the flaky communication of the coupled infrared towers that sent broadcast messages to the team of RCX robots.

Then the NXT came out, and I started my collaboration with LEGO as a MDP in late 2006. The NXT has Bluetooth, but that still does not solve the problem of broadcast communication,

where you have a unit sending data to multiple clients. In fact, Bluetooth is designed for point-to-point communication, with a master/slave scheme that is the opposite of broadcasting. NXT firmware allows only three slaves to be connected to a master NXT, thus limiting the maximum size of a team of mobile robots.

I began to wonder if it would be possible to enable Wi-Fi communication on the NXT, before other third party Wi-Fi adapters (from Dexter Industries and Humarobotics) came out. I didn't have any company behind me to support the development. I started making a working prototype based on the Flyport, a opensource Wi-Fi enabled controller made by openPICUS (http://www.openpicus.com/site/products)

THE GREAT OPENPICUS TEAM

Flyport is a powerful and low-cost system on module (SOM) with embedded Internet connectivity. Since every product of openPICUS is released as open source and is well documented, I could easily design a simple prototype board to connect the Flyport to the NXT, using the high speed serial port RS485 built in Sensor Port 4. I thought the idea was interesting and new, so I contacted the openPicus team, which is actually made up of two smart Italian engineers, Claudio Carnevali
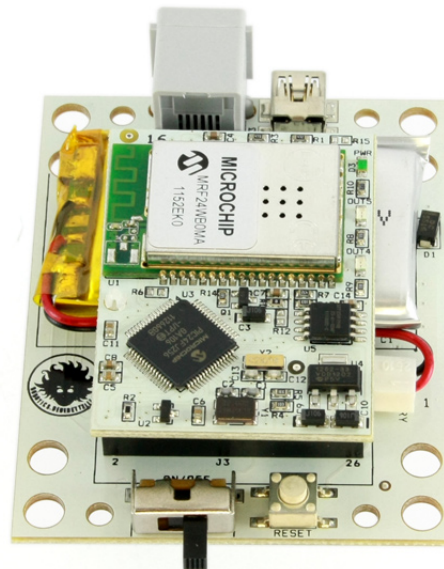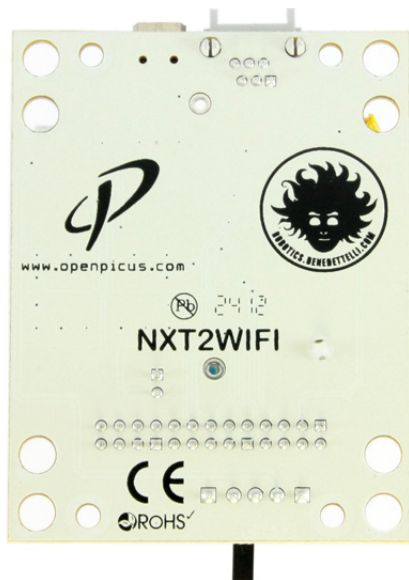
and Gabriele Allegria. We started a fruitful collaboration at a rather slow pace, mainly because I was working full time for a company, so my spare time for LEGO® was quite limited. OpenPICUS believed in my idea, and had the infrastructures to bring the NXT2WIFI onto the market, from homebrew prototype to fully industrialized product.

DIFFERENCES WITH SIMILAR THIRD PARTY PRODUCTS

During the development, Dexter Industries came out with its Wi-Fi adapter, but I was not discouraged, since my NXT2WIFI was meant to be much different, in terms of hardware and software. NXT2WIFI has a built-in rechargeable battery, and a firmware that can be updated and customized according to the needs of the user. NXT2WIFI supports every kind of network and security (WEP, WPA), it has a built-in flash memory to store rich webpages. It features a webserver, so you can control your LEGO NXT creation from everywhere in the world, just by connecting to the fully customizable webpage contained in the NXT2WIFI adapter. This means that you can control your LEGO MINDSTORMS NXT robots using any web browser enabled device, also including iOS devices: iPhone, iPad, iPod Touch. The webpage can be customized using a WYSIWYG editor, so the user does not have to bother with JS coding at all.

THE BETA TESTING

After dozens of firmware development hours, firmware 1.0 was ready in February 2012. I wrote a library for the NXC programming language, but I needed to cover other languages. I asked my MCP fellows, LEGO MINDSTORMS experts and friends Mark Crosbie and Xander Soldaat to beta test the device and write the libraries for it. They came up with many useful suggestions on how to improve the communication protocol and helped in developing the libraries for NXT alternative languages as LejOS and ROBOTC.

CROWD FUNDING

With Claudio Carnevali, I decided to get the money needed to make the first batch of devices using crowd funding. We believed in the project, but we wanted to test the market,

avoiding personal risks. The successful crowd funding campaign took place from March to May 2012, using the Italian crowd funding portal EPPELA (http://www.eppela.com) http://www.eppela.com/eng/projects/162/nxt2wifi-modulo-webserver-per-lego-mindstorms-robots

Besides the niche target of the product, the fact itself of having used the alternative way of getting funds from passionate people and hackers, attracted quite a lot of attention from Italian newspapers and television.

THE LAUNCH

The NXT2WIFI was launched in October 2012, that is quite late, considering that a new LEGO MINDSTORMS generation was going to be revealed in February 2013, the EV3 generation. The EV3 generation is Wi-Fi enabled, can be controlled with iOS devices, but still misses the onboard graphic webserver. However, there are many NXTs still around, and it will take time before the EV3 becomes as mature a development platform as the NXT, in terms of alternative programming languages and alternative firmwares.
In December 2012, I published a video in which a team of many NXT robots dance in sync, remote controlled by a custom Android App that broadcasts commands over UDP.

CONCLUSION

This adventure, thanks also to the wonderful people I met during the process, taught me how to bring an idea to market. My first real product, on which I could print my logo. I finally could make a really big team of mobile robots dancing together in sync! The team can be theoretically infinite, in my case it was limited by the number of NXT I had! A swarm of NXT robots is ready to take over the world!

LINKS

Official support page http://nxt2wifi.benedettelli.com

NXT ballet http://www.youtube.com/watch?feature=player_embedded&v=yP41p8Aipw8
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