Why robotics in Education?

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Why robotics in Education?

“A Picture Is Worth A Thousand Words“
Why robotics in Education?

- Emotional engagement
- Interaction with physical devices
- Learning by doing
- Multi-disciplinary learning
- Constructivist approach
Why robotics in Education?

- Robots have an intellectual and emotional appeal that transcends any other type of engineered product.
- Robots inculcate an interest in science and increase self-esteem, as well as teach basic life skills such as problem solving, decision making, goal setting and logical thinking.
- Robots represent a practical application of physics, computer science, engineering, and mathematics, and may be used to speculate about concepts of humanities.
- Robotics in the classroom offers teachers the opportunity to bring together many different areas of study.

(adapted from Ken Berry, Founder of RoboEducators)
Why robotics in Education?

• It also allows students the chance to realize their full potential, moving from possibility to reality through a hands-on process that uses their many skills as a human being including cooperative problem solving and critical thinking.

• Robot can also used to teach humanities (like ethics, philosophy, etc.)

• Robotics its-self is a discipline worth to study because the robots are no longer restricted to the factory floor or hazardous environments, robots are making their way into human environments.

(adapted from Ken Berry, Founder of RoboEducators)
What robotics can teach?

- Endow rigor
  - Learn something real
  - Teach the realities and depth of science

- Design
  - Use tinkering to explore
  - Connect high and low level issues
  - Learn uncertainty and variability of the world

- Work in teams
  - Competitions are an exciting performance assessment
  - Foster team spirit and camaraderie
Constructionism and Robotics

- Constructionism adds to constructivism (learning as “building knowledge structures”) the idea that learning is felicitous in a context where the learner is consciously engaged in constructing a public entity, whether it’s a sand castle on the beach or a theory of the universe.

- The Lego Robotic system leads to a bottom-up oriented developing of the first phase: starting from the basic brick, which defines the fundamental standard for all the other elements of the Lego kits, you can build more and more complex architectures combining simpler, already realized parts and a robot is a public entity.
Constructionism and Robotics

- Learning is open-ended
- There are not right and wrong answers
- In a taught class the learning is limited, in a project class there is no upper limit to learning.
- In a design competition, students are encouraged to explore fields and solutions beyond topics covered in class.
- Design teachers often grade as B the meeting of the class requirements and as A if the requirements are exceeded in some way.
Why Lego Mindstorm?

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Several educational robot kits

Electronics/mechanics kits

Humanoid robot kits

<= Simple

Robotic Arm

Robovie-i

Bioloid Beginner Kit

Robovie-M

More complex =>

Walkers

HemiPars - Designed for Education
Advantages of Lego Mindstorm

- students have a previous experience with Lego bricks
- it has robust software and hardware
- is a good tradeoff between complexity and possibility
- simulation environments are available more and more
  (one can avoid to buy a kit for every student)
- several third parts software and hardware to enlarge experimenting possibilities
- The kit cost allow the students to buy one to continue experimenting at home
Advantages of Lego Mindstorm (from teacher perspective)

- it is a widely used platform (several resources on the web)
- Educational activities developed by other schools are on the web
- The Mindstorm NXT-G graphical interface is built on LabView and allows a step by step migration to programming in LabView. [One start programming the robot in NXT-G, then control it through LabView, then he/she programs in LabView other instruments.]
Advantages of Lego Mindstorm (from teacher perspective)

- It comes straight from Papert experience
  - Logo -> Dacta --> Mindostorm

- ??? PLEASE HELP:
  from Terecop partner with knowledge on history of constructivism ???
LEGO© Mindstorms Educational Kit

IT+Robotics Srl
A spin-off of the University of Padova
The Mindstorm NXT Kit educational

- In the two boxes you have:
  - Hundreds Hardware pieces
  - 5 Different sensors
  - 3 motors
  - Programmable brick to control motors and sensors

- To be bought apart:
  - Mindstorm NXT-G visual programming environment
What you can find into LEGO© Mindstorms Educational Kit?

Mindstorms gray box

Educational blue box
• LEGO® MINDSTORMS
• Gray box contains:
  • The NXT
  • Sensors
  • Servo Motors
  • Basic LEGO Mindstorms pieces
  • USB cable
  • RJ12 cable
LEGO® MINDSTORMS Educational
Blue box contains:

much more LEGO Mindstorms pieces to express your imagination
The NXT is the brain of a MINDSTORMS® robot. It’s an intelligent, computer-controlled LEGO® brick that lets a MINDSTORMS robot come alive and perform different operations.
NXT: the brain

- 32-bit ARM7 microcontroller
- 256 Kbytes FLASH, 64 Kbytes RAM
- 8-bit AVR microcontroller
- 4 Kbytes FLASH, 512 Byte RAM
- Bluetooth wireless communication
- USB full speed port (12 Mbit/s)
- 4 input ports, 6-wire cable digital platform
- 3 output ports, 6-wire cable digital platform
- 100 x 64 pixel LCD graphical display
- Loudspeaker - 8 kHz sound quality.
- Power source: 6 AA batteries
The Touch Sensor gives your robot a sense of touch.

The Touch Sensor detects when it is being pressed by something and when it is released again.

You can use the touch Sensor to make your robot pick up things: a robotic arm equipped with a Touch Sensor lets the robot know whether or not there is something in its arm to grab.

You can use a Touch Sensor to make your robot act on a command.
The Sound Sensor makes your robot hear!

The Sound Sensor can detect both decibels [dB] and adjusted decibel [dBA]. A decibel is a measurement of sound pressure.

The sensitivity of the sensor is adapted to the sensitivity of the human ear. In other words, these are the sounds that your ears are able to hear.

Also, the sensor can detect some sounds that are too high or too low for the human ear to hear.
The Light Sensor is one of the two sensors that give your robot vision.

The Light Sensor enables your robot to distinguish between light and dark. It can read the light intensity in a room and measure the light intensity of colored surfaces.

You can make a burglar alarm robot: when an intruder turns on the light in your room the robot can react to defend your property.

You can make a line-following robot or a robot that can sort things by color.
The Ultrasonic Sensor enables your robot to see and detect objects.

You can use it to make your robot avoid obstacles, sense and measure distance, and detect movement.

The Ultrasonic Sensor measures distance in centimeters and in inches. It is able to measure distances from 0 to 255 centimeters with a precision of +/- 3 cm.

The Ultrasonic Sensor uses the same scientific principle as bats: it measures distance by calculating the time it takes for a sound wave to hit an object and return – just like an echo.
Servo Motors

The three Servo Motors give your robot the ability to move.

If you use the Move block in the LEGO MINDSTORMS NXT software to program your motors, the two motors will automatically synchronize, so that your robot will move in a straight line.

Built-in Rotation Sensor
Each motor has a built-in Rotation Sensor. This lets your control your robot’s movements precisely. The Rotation Sensor measures motor rotations in degrees or full rotations [accuracy of +/- one degree].

The built-in Rotation Sensor in each motor also lets you set different speeds for your motors.
The LEGO® MINDSTORMS® NXT software enables you to program your NXT robotic invention and upload your programs to the NXT via USB or Bluetooth connectivity.

The intuitive Mac and PC compatible drag and drop software, powered by National Instruments LabVIEW, comes with building instructions and programming guides to easily begin constructing and programming with MINDSTORMS NXT.
Important Accessories

**Battery pack** for rechargeable battery

**Standard 9v transformer** plugs into an AC outlet to recharge your battery

**Bluetooth pen**
Enable wireless communication between your LEGO® MINDSTORMS® NXT robot and your PC or Mac

**USB 2.0 cable** to connect your PC to your robot and program it

**RJ12 cable** to connect the sensor to the NXT
Understanding NXT-G Software

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NXT Software (first screen)

1. First Directions

2. Tutorials on each program block

3. Programming Command Palette

4. NXT File manager
   Press GO to start programming!

5. HELP
NXT Software (programming canvas)

1. Canvas where you drop the program blocks

2. Controller

3. Selector of
   - standard palette
   - complete palette
   - custom palette
NXT Software (the controller)

Connect to NXT
Download & Run
Selected program
Download & Run
Download
Stop
NXT Software
(program blocks)

» **Common palette**
Contains the most commonly used programming blocks.

» **Complete palette**
Contains all the various programming blocks.

» **Custom palette**
Contains downloaded blocks and the blocks you make yourself.
NXT Software
(program blocks)

For a detailed description of the single program blocks refer to the “Appendix A - Program Blocks”
Other languages & platforms to program NXT robots

UPNA
Public University of Navarra
When using other alternatives to program NXT we should check:

Type of interface

Type of language

Needs new firmware or no

Etc....

At the end the reader will find a link to the “teamhassenplug” web page with a complete list of the features that we should check.....
LEGO® MINDSTORMS® NXT

http://www.ni.com/academic/mindstorms/works.htm

The LEGO MINDSTORMS NXT software enables you to program your NXT robots and download your programs to the NXT via USB or Bluetooth connectivity. The drag and drop software, powered by National Instruments LabVIEW, comes with building instructions and programming guides to easily begin constructing and programming with MINDSTORMS NXT robots.
LabVIEW Toolkit for LEGO® MINDSTORMS® NXT

http://zone.ni.com/devzone/cda/tut/p/id/4435

Program your LEGO MINDSTORMS NXT using NI LabVIEW

• Program and control LEGO MINDSTORMS NXT with the full power of LabVIEW
• Get real-time updates from the NXT during program operation with LabVIEW front panels
• Create native Blocks for the MINDSTORMS NXT
Next Byte Codes & Not eXactly C (NBC & NXC)

http://bricxcc.sourceforge.net/nbc/

Next Byte Codes (NBC) is a simple language with an assembly language syntax that can be used to program LEGO's NXT programmable brick (from the new LEGO Mindstorms NXT set).

Not eXactly C (NXC) is a high level language, similar to C, built on top of the NBC compiler. It can also be used to program the NXT brick. NXC is basically NQC for the NXT.

What is leJOS?

leJOS (pronounced like the Spanish word "lejos" for "far") is a tiny Java Virtual Machine. In 2006 it was ported to the LEGO NXT brick.

leJOS NXJ offers the following:

* Object oriented language (Java)
* Preemptive threads (tasks), Recursion, Synchronization, Exceptions
* Arrays, including multi-dimensional
* Java types including float, long, and String
* Most of the java.lang, java.util and java.io classes
* A Well-documented Robotics API
RobotC for LEGO® MINDSTORMS® NXT : http://www.robotc.net/index.htm

RobotC is designed for engineering, programming and robotics education.
pbLua for LEGO® MINDSTORMS® NXT:
http://www.hempeldesigngroup.com/lego/pbLua/index.html

an exciting new text-based language for the Mindstorms NXT; it has these characteristics:

1. It's written in portable C, with minimal runtime requirements
2. It can be compiled on the fly on the target machine, which is the NXT in our application
3. It's a small, easy to read, and easy to write language
4. It has extensive documentation available online, and a very friendly newsgroup
NXT Programming Software Comparison:
http://www.teamhassenplug.org/NXT/NXTSoftware.html

Other possibilities:

URBI (Universal Robotic Body Interface) for NXT:
http://www.gostai.com/lego.html

LEJOS OSEK is an open source firmware for LEGO MINDSTORMS NXT
http://lejos-osek.sourceforge.net/