LEGO Mindstorm NXT 2.0

What is Mindstorm NXT 2.0

- Lego Mindstorm NXT series are programmable robotics kits

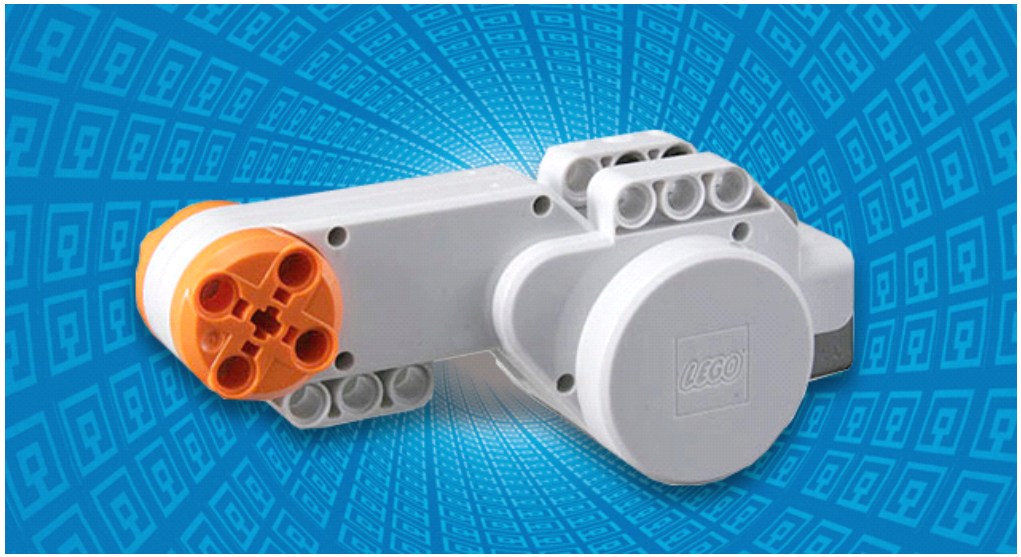
- NXT 2.0 (8547) is latest release, launched on August, 2009

Components

- NXT Intellgent Brick
  - 4 sensor connectors (RJ12)
  - 3 motor connectors (RJ12)
  - Speaker
  - USB
  - Bluetooth
  - 100x60 Pixel LED
  - Buttons
  - 6 AA batteries

Motors

- Motor
  - step motor
  - one degree accuracy
- Build-in rotation sensor
  - speed
  - distance



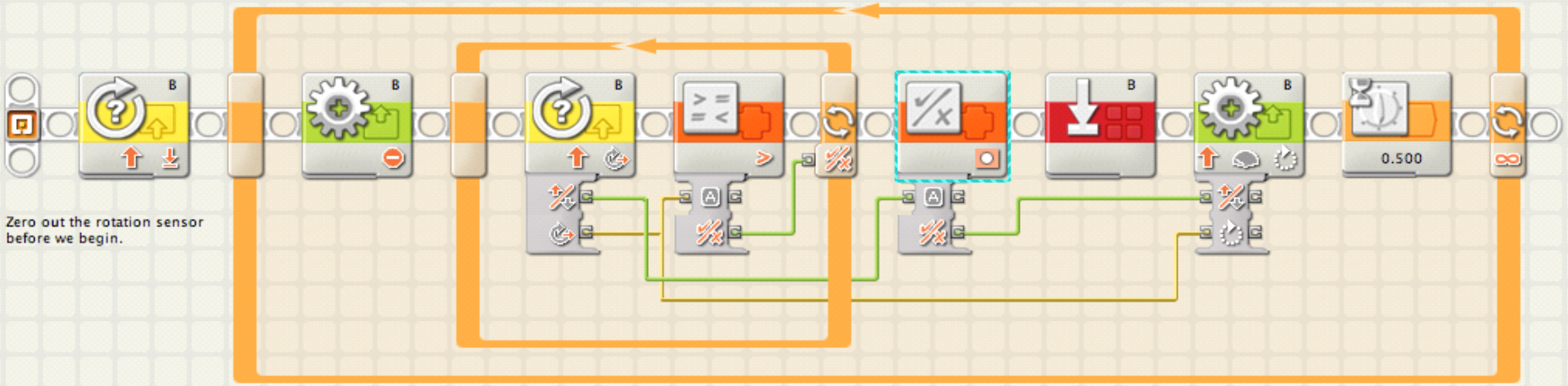
Sensors

- Touch Sensor
  - Button
- Ultrasonic Sensor
  - Distance dectection
- Color Sensor
  - Color recognition
  - Color Light

Programming

- NXT-G
  - NXT-G is the programming software included in the standard base kit.
  - Based on LabVIEW graphical programming.
  - Features an interactive drag-and-drop environment.

PivotBumper:
Intrigued by Sivan Toledo's unique rotation-based front bumper (http://www.tau.ac.il/~stoledo/lego/RTZ/), I decided to code my own "return to zero" code that can handle either direction. While this is not suitable for Mr Toledo's original application (for instance, this code does not wait for the robot to back off from the wall before restoring the bumper to the "zero" position), it shows another way of doing it without some of the Switch structures. The idea: imagine a front bumper that is just a long beam attached at the midpoint to an NXT motor on its side. If the robot moves at an angle into a wall, one side of the beam will encounter the wall beofre the other, resulting in a rotation of the motor... which the program can detect, and then return the bumper to the zero position. As an aside, also note that this doesn't just tell you which side the wall is on, but if you're careful it can estimate what angle the robot is approaching the wall from (compare how fast the bumper turns for, say, one cm of forward travel).



Zero out the rotation sensor before we begin.

Float the B motor by using a Motor block set to stop and "coast" checked.

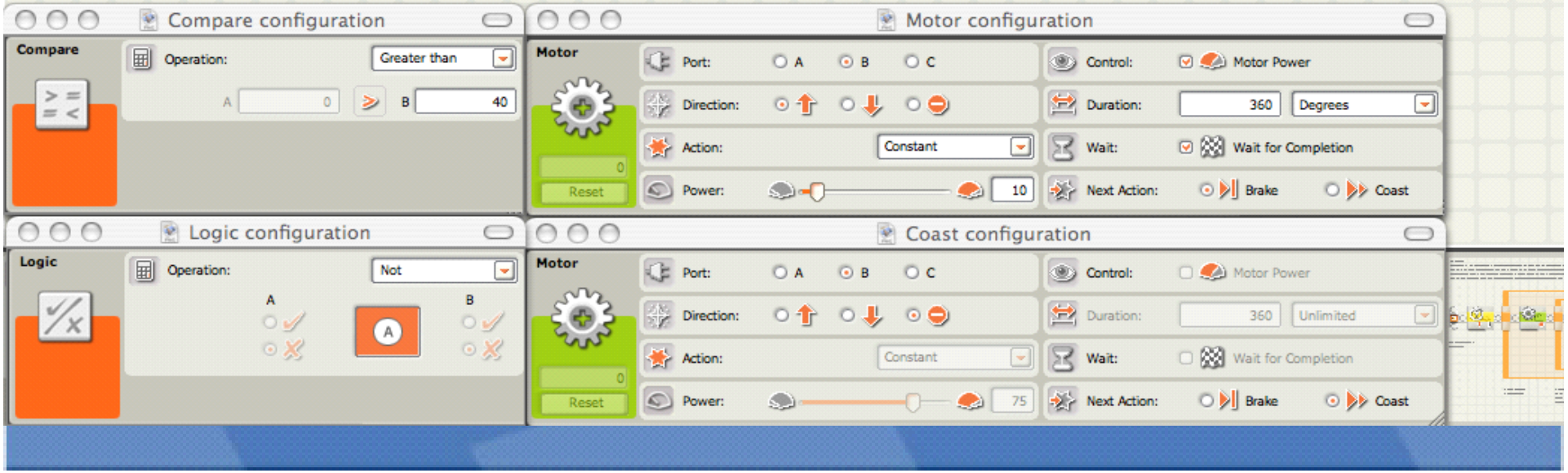
Hang in this loop until the magnitude of the rotation is greater than whatever limit we've selected in the Compare block. Note that we can't do this using the compare in the rotation sensor block itself, because we don't know if the rotation will be CW or CCW, and we want to detect both.

Take the direction of rotation seen by the rotation sensor and invert it using a Logic block set to Not.

Reset the Motor block record of the movement

Now turn the front bumper through a duration equal to the measured angle, but in the opposite direction, and wait for this to complete.

Wait (with the motor braked) a very short time to prevent over-shooting. Note that this isn't actually needed here, as I'm using a fairly low power in the Motor block.

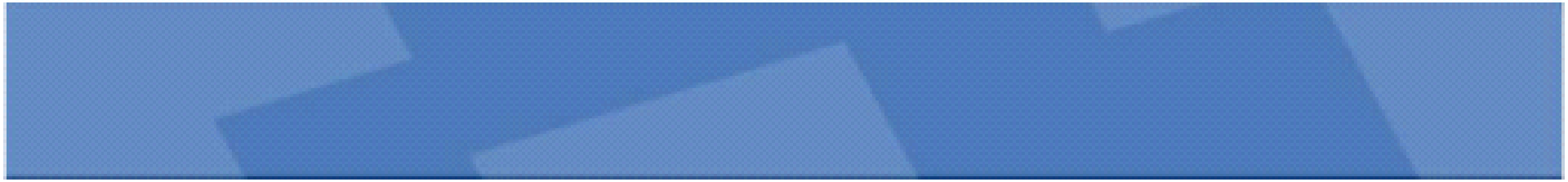


Programming

- leJOS NXJ
  - High level open source language based on Java that uses custom firmware developed by the leJOS team
- BricxCC, Next Byte Codes, Not eXactly C
  - C-like or assembly-like languages
- NXT-Python
  - Python module to communicate with NXT
- Matlab, Simulink, Lua, Ada, Perl, C#...

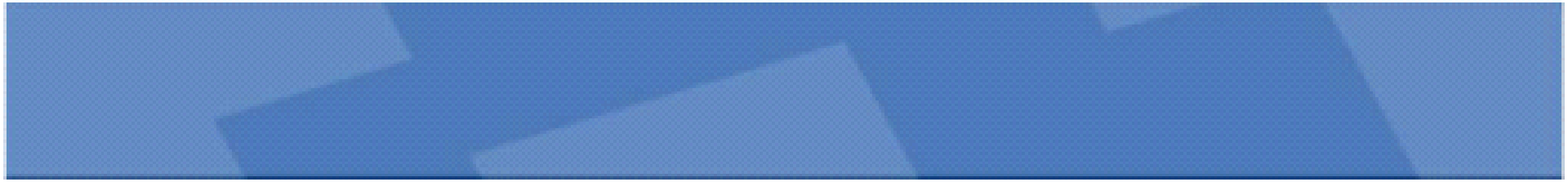
leJOS

Class Summary	
BasicMotor	Abstraction for basic motor operations.
Battery	Provides access to Battery.
Button	Abstraction for an NXT button.
ColorSensor	LEGO Color Sensor driver.
ColorSensor.Color	Extended color class, that includes the background reading at the time that the other readings were made.
Flash	Read and write access to flash memory in pages.
I2CSensor	Class that implements common methods for all I2C sensors.
LCD	Text and graphics output to the LCD display.
LCDOutputStream	A simple output stream that implements console output.
LightSensor	This class is used to obtain readings from a LEGO NXT light sensor.
Motor	Motor class contains 3 instances of regulated motors.
MotorPort	Abstraction for a NXT output port.
NXT	Abstraction for the local NXT Device.
NXTEvent	This class allows communication of event data between the leJOS firmware and the leJOS low level classes.
NXTMotor	Abstraction for an NXT motor with no speed regulation.
NXTRegulatedMotor	Abstraction for a NXT motor.
NXTRegulatedMotor.Controller	This class provides a single thread that drives all of the motor regulation process.
SensorPort	Abstraction for a NXT input port.
Settings	leJOS NXJ persistent settings.
Sound	NXT sound routines.



Open Source

- Lego has released the firmware for the NXT Intelligent Brick as Open Source, along with schematics for all hardware components
  - Software Developer Kit (SDK)
  - Hardware Developer Kit (HDK)
  - Bluetooth Developer Kit (BDK)
- 3rd-party firmware (eg. leJOS)
- 3rd-party sensor (eg. Compass, RFID reader, accelerometer)



Reference

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- http://lejos.sourceforge.net/index.php
- http://www.diy-robots.com/
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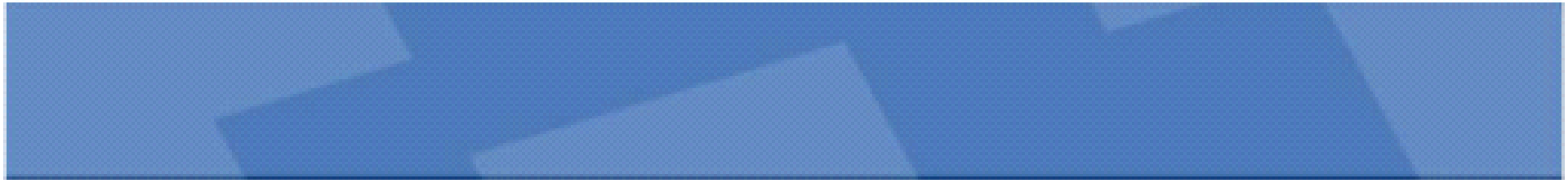

Thank you!

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