

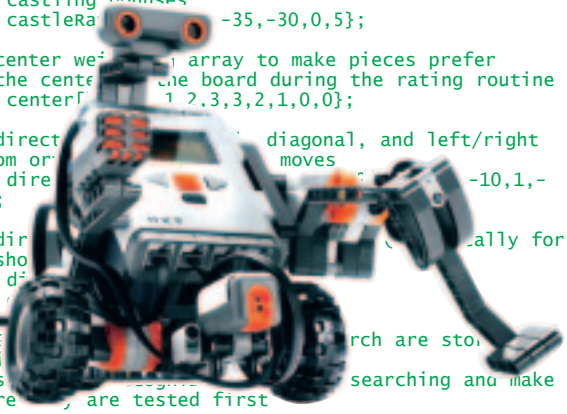
```
// castling bonuses
B8 castleRa [-35,-30,0,5};

//center we... array to make pieces prefer
//the cent... the board during the rating routine
B8 centerF [ 1,2,3,3,2,1,0,0};

//direct... diagonal, and left/right
from or... moves [-10,1,-
1};

//dir... ally for
bisho... ally for
B8 d... ally for
B8 ... ally for

//c... arch are sto...
thi... arch are sto...
//s... searching and make
sure... are tested first
```



A bi-monthly column just for kids!

LESSONS FROM THE LABORATORY

Look What's Coming ... NXT!

by James Isom



In January of this year, after years of speculation from LEGO robotics fans everywhere, LEGO announced plans for a new addition to its Mindstorms robotics line. Officially called LEGO Mindstorms NXT, the sets consist of all new hardware and software packing a host of new features and capabilities guaranteed to channel the inner nine-year-old in all of us.

Over the next couple of articles, we will explore this system in anticipation of its release this August.

The NXT

Table 1 shows a run-down of a few of the RCX features as compared with new NXT features.

Let's start by looking at the new NXT programmable brick. Approximately the same size as its yellow cousin — the RCX — the similarities between the new NXT and the RCX pretty much end there. The first thing you'll notice is the lack of the 2 x 2 sensor pads that formerly served as the RCX's input and output ports. The sensors now attach to the top and bottom of the NXT via connectors similar to phone jacks.

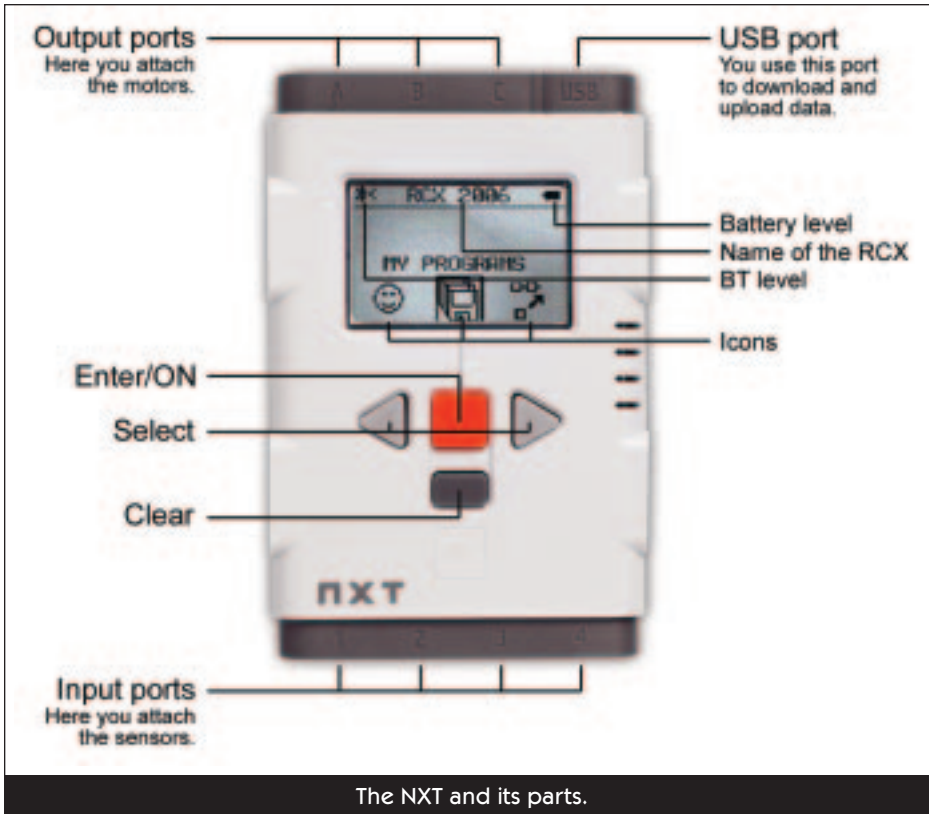
The bottom has room for four sen-

sors and the top sports three power ports, leaving room for the new USB 2.0 port. The USB port replaces the infrared tower as one of two ways to transfer your program from the computer to your robot. Communication

with the host computer or additional NXTs can also take place using Bluetooth wireless technology.

The face of the NXT is dominated by the new 60 x 100 pixel dot matrix display. Navigating between programs

Feature	RCX	NXT
Processor	Eight bit Hitachi Microprocessor	32 bit Arm7 Microprocessor
Communication	Infrared	Bluetooth/USB 2.0
Inputs	3	4
Outputs	3	3
Display	Five digit LCD + the running man	60 x 100 pixel programmable dot matrix display
Programming Space	Five program slots	As many as will fit in 245K of Flash
Power	Six AA batteries	<ul style="list-style-type: none"> Six AA batteries Rechargeable Lithium battery with AC port (educational)



is as simple as scrolling through songs on your favorite MP3 player – the days of having just five program slots to play with are gone. Not only does it allow you to easily navigate between programs, but the NXT also allows you to make simple programs right on screen without the need to be at a computer. You won't be doing any major programming this way, but it's great for a quick demonstration or proof of concept.

The new display can also show simple graphics that can be controlled directly from your program. For example, your robot could roam around the room while displaying a pair of eyeballs looking to and fro. The buttons on the NXT are also programmable. For example, your program can now wait for the left select button to be pressed. The battery pack replaces the bottom of the NXT brick

Like the RCX, the NXT will be powered by six AA batteries. However, if you choose to purchase the education-

al version of the kit, it will include the rechargeable battery pack option that fits in the same space as the six AA batteries. AAs or rechargeable battery? It's up to you, but the rechargeable Lithium battery has a minimum capacity of 670% over the AA option and charges in four hours.

However, because it is a Lithium battery, it will work with a partial charge and will never be in danger of overcharging (and psst! – the rechargeable option is better for the environment). The battery pack also includes an AC adapter jack allowing you to run from direct power for those long term experiments or crazy ball contraptions.

The Sensors

The current LEGO robotics system supports four sensors: touch, light, rotation, and temperature. The new NXT system supports most of the same, along with a couple of new ones.

The Touch Sensor

The touch sensor is pretty much the same as the previous touch sensor. The big difference is the addition of an axle hole on the touch pad.



The Light Sensor

The new light sensor is much more sensitive than its older cousin with the ability to pick up finer gradations of light than ever before. A problem with the previous light sensor was that if you were trying to read ambient light values, it would sometimes be influenced by its own light source. This has been solved in the new version with the ability to turn the light source on and off from within your program.



The Sound Sensor

The sound sensor is new for the NXT and will allow your robot to sense tones and sound patterns. Can anyone say "Clap on! Clap off!?" Two claps for right, one for left? There are lots of fun possibilities here.



The Ultrasonic Sensor

Ultrasonic sensors have long been a staple of the hobby robotics realm, and now the NXT has one, too. You'll be able to sense objects at a specific distance or react to movement in the room. This will make navigating a room without ever touching an object finely a possibility.



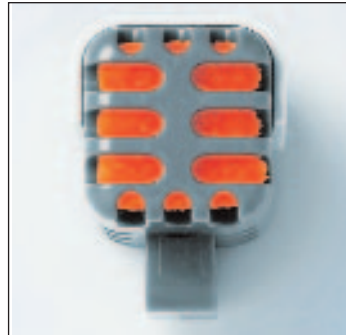
Now, many of you might be saying, "Hey where's the temperature and rotation sensor?" LEGO is not releasing a



Touch sensor.



Light sensor.



Sound sensor.



Ultrasonic sensor.

new temperature sensor at this time, although I am sure a third party solution won't be long to market. If you absolutely need a temperature sensor for your application, you can use the converter cables that will be available in the educational sets. These cables can be used with any of the previous motors and sensors to interface with the NXT brick.

Even if have a few of the old rotation sensors laying around, you might not always need them with the NXT. The new NXT motors have rotation sensors built into them and are actually servos. A servo is a motor that automatically adjusts itself to move a certain amount. This allows very precise movements, giving you much more accuracy than the previous system ever allowed and, now that each motor has a rotation sensor built in, not only will it not take up a valuable input port, but with sensors in

each motor, it will be far easier to make your robot drive in a straight line.

The Software

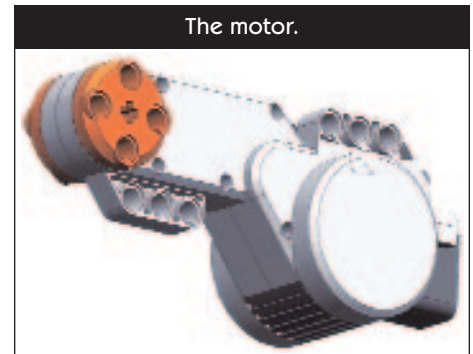
The new NXT software looks great — easy to use, easy to learn, with a robust set of features. It will run on PCs running Mac OSX or Windows. I'm not going to go too deep into it at this point because I'll be spending a whole article on this in the coming months.

For those of you who can't live without your Robolab, you will be happy to know that there is a 3.0 version planned. Robolab 3.0 will be compatible with both the RCX and the NXT. Rumor has it that it should be available about the same time the NXT hits the street, but don't tell anyone I told you.

For more information

on the new system, check out the Mindstorms NXT blog at <http://legoeducation.typepad.com/>

I'll be back in June with more on the new Mindstorms NXT robotics system. Until then, have fun! **SV**



The motor.



An RCX to NXT conversion cable.

The battery pack replaces the bottom of the NXT brick.



NXT motors and sensors.

