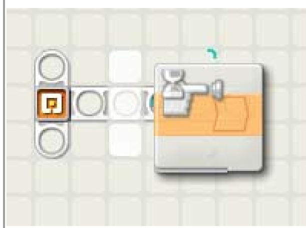
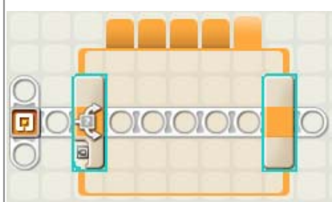
NXT-G Tips & Tricks

These are a collection of NXT-G tips & tricks written by Brian Davis. These are not "official" tips, just a collection of his own thoughts and rules when he uses NXT-G V1.1

First Rule of NXT-G: Don't rush the editor. When you are inserting a block between existing blocks, you can click & drag it in to position so the 1x3 "shadow" shows in the right place... but don't actually drop it until the editor makes room for it. For reasons unknown, the editor seems to get "lost" most often if you rush it, and assume that it knows where all the drops, clicks, and releases in an editing sequence were.	
Second Rule of NXT-G (&, really, everything else on a computer): "Save Frequently, Save Often ". Because you never know when something you did might pervert something that was working before, or when the editor might crash. Don't save over working copies with the same name, but save "new versions" of programs (& My Blocks!), so you can always backup a step or three.	
Third Rule of NXT-G: Use My Blocks. These save huge amounts of memory, promote good coding, make things more readable, etc. About the only bad thing I have to say about My Blocks is you can occasionally (OK, I'm the only one I know who's done this) get them so they seem "broken" in the editor, but the compiler will still produce perfectly good code from them; that looks bad but seem to work fine. As far as learning to program, I'm beginning to think My Blocks promote reusable, self-contained code more than most text-based languages do.	
4) Switches look great in "flat" form - now get rid of them. The "tabbed" form is both more useful (you can wire in & out of it in tabbed view, and can have more than two states) & more stable (possibly because it's much closer to how NI does this in LabVIEW, while the "flat" format may be a special adaptation for NXT-G only).	
4.1) When wiring within a tabbed Switch structure, the	this needs a picture

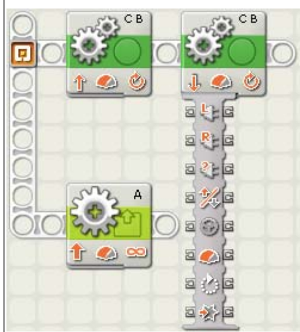
wiring works fine in the "first" tabbed field (the "true" field of a logical Switch, for example), but does funny "straight wires to infinity" things in the other fields. You can wire up things on the sequence beam behind a Switch, and then select the entire thing (wires too) and drag it in to make your life easier.

5) Don't use variables when a wire will do. I know every one of us from text-based languages finds this hard to handle, but NXT-G handles wiring values forward better in some cases than it does actual variables (among the problems: all variables are global, and long variable names aren't visible).

6) When wiring, first give yourself plenty of space in Switches & Loops (the old "crowbar & pin" routine). Do it once, and you don't have to do it again. Then use wires in ways that make sense to you (not just "hook up two points"). Clicking at an intermediate position allows you to "Tack" the wire to that point, and bend it another way along the next segment.

7) Try to resist the multiplication of sequences (tasks)every time you think you need to do "something else". First, that slows things down and often isn't needed.

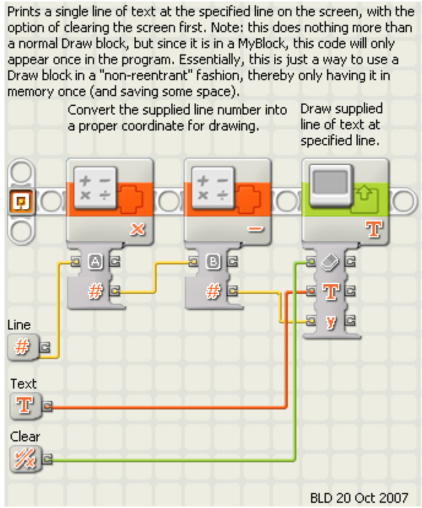
Second, while NXT-G is pretty good on editing the first sequence... it's much poorer on the second, third, etc. Likewise splitting off a sequence from mid-sequence can work great if it's the last thing you do, but if you add/subtract any blocks ahead of that split later... things can get decidedly odd. Avoid if at all possible.

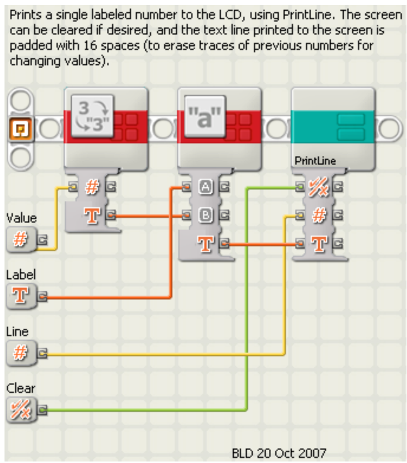


8) Debug with blocks that make your life easier, not harder. Below are two My Blocks that end up in nearly every program I write, because they're easy to use, and therefore make debugging insanely easy as well, PrintNumber and the block it calls, Printline

Note these are not complex or difficult My Blocks - in fact, you might think why bother at all. But with	PrintLine.rbt (202.87k)	PrintNumber.rbt (181.86k)

PrintNumber, I can drop a single block and that's all I need to get labeled, formatted numerical output on the LCD. Nothing earth-shattering... but it makes debugging easy instead of a task. And by having one My Block that calls another, I can make sure that these blocks only exist in memory ONCE, and all my simple screen prints are done through them. Saves memory, and the only cost is that I can't have two parallel sequences drawing to the LCD at once (and if that happens, actually, one just waits for the other, so 9 times out of 10 you don't even notice it).





Simple Sound blocks that "beep" at a different tone are another good example of debugging.

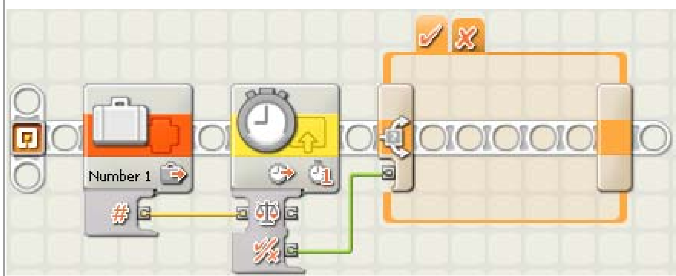
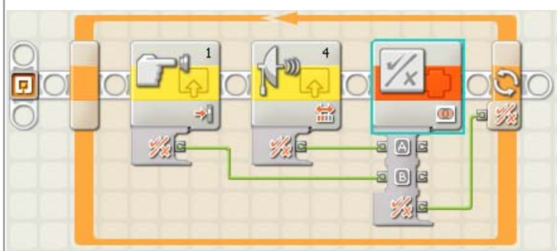
9) Option-dragging (on the Mac, Ctrl-dragging on the PC) an existing block (or series of blocks) clones them, with all their internal settings preserved. In other words once you have that "Motor B" block on the programming field, you need never go to the pallet to drop a new one and reconfigure it yet again, just "clone-drag" an existing block.

10) Have I mentioned "Wait for the Editor" yet? And if you get tired of the editor taking so blasted long to shift things, and all the icons in the map view in the lower right-hand corner look like single pixels... see Rule Three (but before you do it, use Rule Two again).

11) The great Copy-Paste issue. I don't know why, but I've not had good luck with this. However, Option-drag (Ctrl-drag)has been just great. So the result is the only time I personally use a Copy-paste type edit is when I'm taking something from one sheet and trying to get it into a second, different sheet.

12) Oh, and for designing those My Block icons, you can drop multiple overlapping icons, as well as resize them. Deleting an icon however had me stumped for a very long time. On the Mac, you need to select the icon you want to remove, and hit fn-delete ("function

delete"). Actually still the only use for the "fn" key on my computer I've ever needed. (just "Delete" on the PC)
13) Incomplete sequence beams through a Loop & other odd structures. Ever had a Switch in side a Loop, and for some reason the sequence from the end of the Switch doesn't reach the tail of the Loop? This is a sign that the editor is starting to miss things. One way to fix it is to grab and pull free the entire Switch, and then replace it (being careful to follow Rule One above), and you'll find the editor has "found" the connection again. Likewise sometimes deleting the last block out of a Loop (particularly a Loop set to trigger on a sensor) will result in a Loop with no internal "space" to seed block into. If that's the case, deletethe loopand drop a new one.
14) Undo for Mental Health: In general, if something looks wrong... assume it is. Either re-do it (following Rule One), or use the other fantastic hidden tool at your disposal, "undo" (either from the edit menu, or the keyboard shortcut). This seems to work really well, even undoing the polite "rewiring" NXT-G sometimes (often) tries to do for you.

15) You can't wire into a Wait (to have the program set a condition that wasn't know at compile time) or a Switch... but you can always use CompareLogic blocks to come up with a condition, and set the Switch to select on logical, or wire a value into a Loop that does some internal checking to produce a logical that controls the Loop. Honestly, I think the default dropped state for	 

the Loop and Switch should be "control on logical", as this is such a useful concept... and avoids some of the issues that crop up in #13 , above.	
16) Clipping wires: selecting a wire and hitting delete not only removes it, but every wire attached to it, not just annoying but it can make you loose track of where the wires were coming from / going to. But if you click on the downstream (output) end of a wire, only that little branch is removed, preserving the rest of a multiply-branchin g wire. Oh, and while we're discussing wires (again), if you have a wire with a "bend" in it, but it's not the way	

you want it ("up and over" when what you need is "over & up"), just tap the space bar.	
17) When no block is selected, the "1", "2", & "3" keys will select the pallet you want forward. Also the "tab" key cycles through the tools.	
18) If possible, don't mess with the directory structure. NXT-G is really good about finding things (My Blocks, for instance) that have been moved... but not always, and searching takes time, especially when you open a program.	

NXT-G Blocks

This is a collection of blocks people have made for **NXT-G** , using NI's LabVIEW NXT Toolkit. The blocks will load directly into the Mindstorms software, once the Dynamic Block Update is installed. (only needed for NXT-G V1.0)

Advanced Display Imageblock

This block uses some very interesting and not well documented features of .ric files, by allowing users to pass parameters to the image. This block is limited to five parameters. The zip includes meter.ric, that works like a volt-meter.

To create an advanced ric file, use Andreas Dreier's RIC Editor

Also useful: Advanced Display Text Block by Guy Ziv (thanks for showing how some of the stuff is done)

[Line Following block]

This block should be placed in a loop, and will cause drive the motors at the speed specified, so the robot can follow the edge of a line, with a single light sensor.

My tests show this single block will execute about 2 to 3times as fast asthe same codein NXT-G.

[Bit Logicblock]

This block will do bitwise operations on numbers (And, Or, Xor, and Not).

I'd love to take credit for this, but the block actually come from [Michael Gasperi]. He created this block, and asked me to take a look at it. I made some changes, and passed it along to Brady (at National Instruments) whomade some improvements before sending it back, where I made even more improvements. Now, it's a pretty nice little block, that's easy to use and looks good. (added 2/28/07)

[Simple Array block] v2.0

The array block is a repackaged sub-block. It will allow you to Clear the array, Add values, Get and Replacevalues given the index.

[Display Number block] v2.0

I made this block as a debugging tool. It combines several blocks that (due to program limitations) could not be compiled into a My Block. The block takes a line number, a caption, and a number as input. The Caption and Number are displayed on the given line on the screen.

Installing Interger Blocks (NXT-G 2.0)

When you load v1.0 or v1.1 programs in NXT-G v2.0, you'll see some blocks (like the math block shown) have an (!) on them. These are interger versions of blocks that have been updated in v2.0 to be floating point blocks. These blocks are installed with v2.0, but do not appear on any pallet.

To add them to a pallet, simply create an empty file in the BlockRegistry directory,in the pallet sub-directory, with the name of the block and a .txt extension.

Ex: [LEGO MINDSTORMS directory]\engine\EditorVIs\BlockRegistry\Data\Numeric Operations.txt

The list of available blocks is located in: [LEGO MINDSTORMS directory]\engine\vi.lib\LEGO\Blocks\

If this doesn't make sense, you probably **shouldn't do it.**

Display Timeblock

This block is a combination of many other things. It's a modified version of the display number block that willdisplay the value of a timer in minutes and seconds. (added 2/28/07)

Acceleration Sensor block

This is the first block I made. The Configuration panel is not complete. It works with one of the prototype acceleration sensors from Hi-Technic. It has outputs for X, Y & Z. It can not be used as a loop block condition, because I didn't finish that part.

I've added some better pictures that Andy created and posted on NXTasy.org - Thanks Andy

HiTechnic has a better version of this block

Tools

This is a very small collection of tools.

Blank Image (1x1)

This .ric file contains a blank image that can be used to erase one pixelon the NXT screen.

In NXT-G, this image will show as a couple smalllines, however on the NXT, it will only show as one blank pixel.

The image should be Saved to your Pictures directory...

[LEGO MINDSTORMS directory]\engine\Pictures\

Blank Image (??x??)

This .ric file contains a blank image that can be used to eraseparts of the NXT screen. The default image is a 1x1 pixel.

Using "Advanced Display Image Block" (above) you can pass parameters to set the width & height (as parameter 0 and parameter 1) up to 100 x 64.

In NXT-G, this image will show as a couple lines, however on the NXT, it will only show as one blank pixel.

** this image may not work with the normal display block in NXT-G **

The image should be Saved to your Pictures directory...

[LEGO MINDSTORMS directory]\engine\Pictures\

NXT-G Add-Ins

The following are small programs that can be added to NXT-G. To install them, simply save them into the project folder in the NXT-G directory, and they will appear under the "tools" menu in NXT-G.

[LEGO MINDSTORMS directory]\engine\project\

As a rule, if you can't get them to work, don't use them. But, one of the best places to ask questions is NXTasy.org

These are from various locations. Several came from Jason King. (Thanks Jason)

Config popup

Show configuration panel in a floating window. Good for mini-PCs, with a resolution of ????x600. You must select the type of block in the window, before selecting the block in the editor.

Download to file

Compile a program, and save it to a file. Useful when writing aprogram, without having an NXT connected to the computer.

Modify User Settings

Change some setting for a pre-selected user.

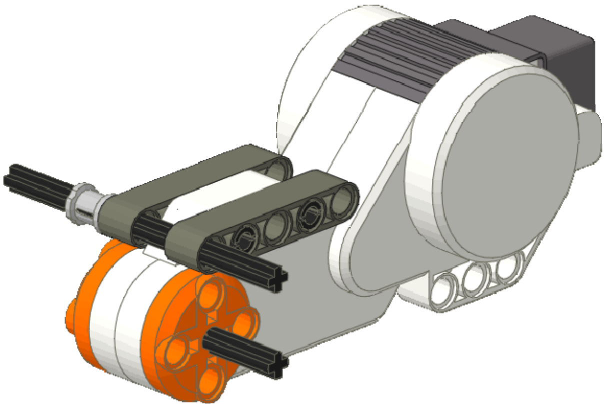
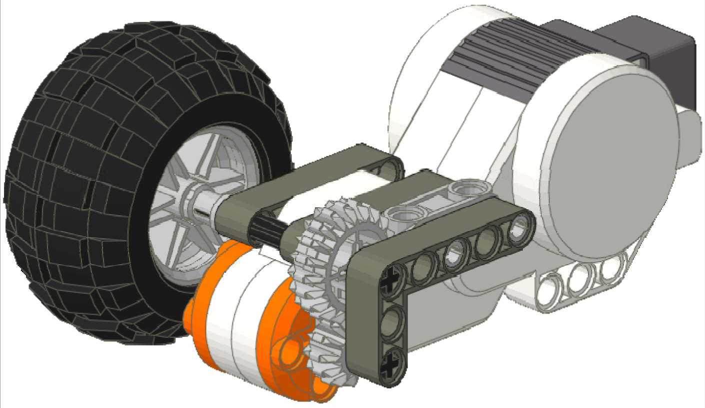
Remove bad wires

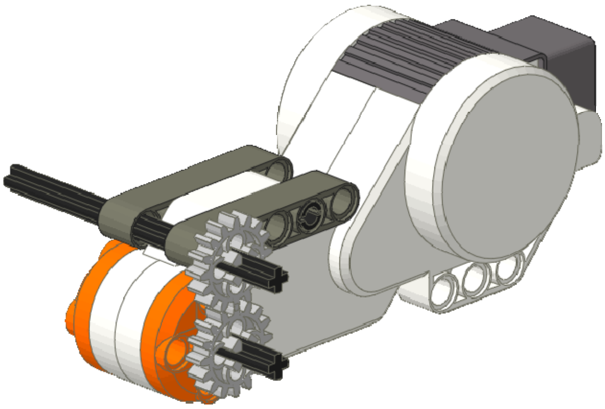
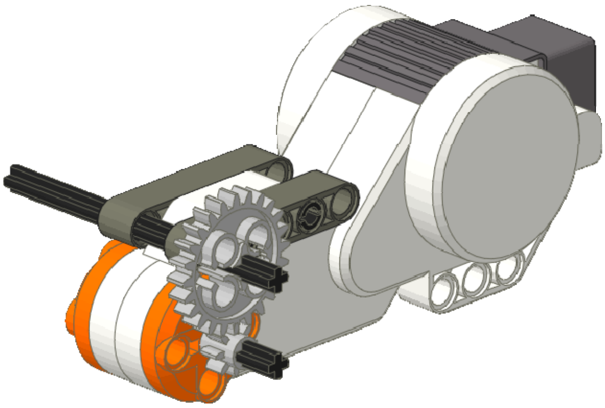
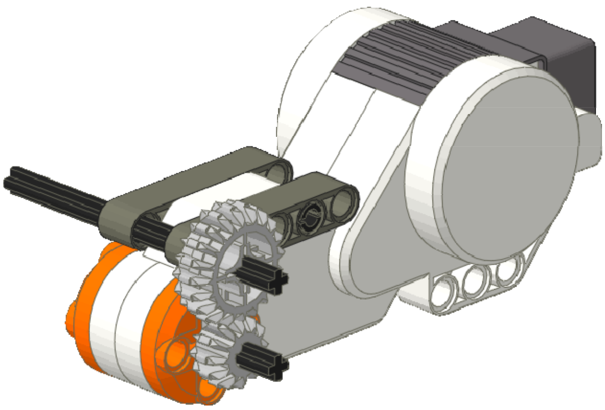
Removes bad wires.

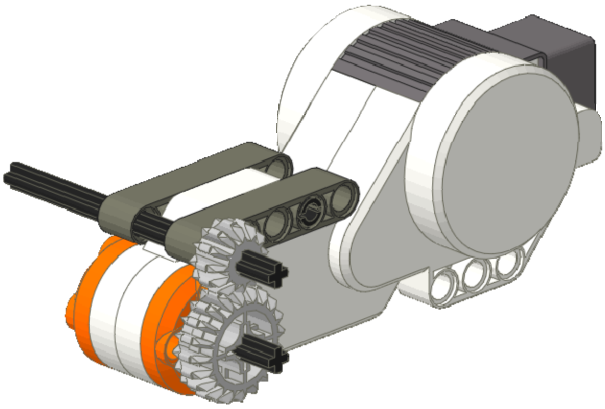
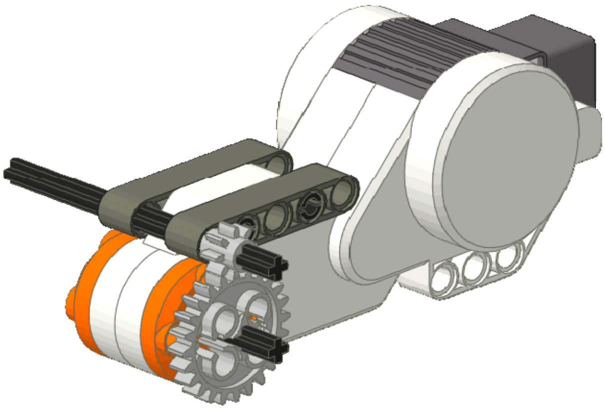
Save Screen Image

Will save the selected image from the screen. Good for saving Config panel images.

Gears

This small assembly will provide a solid method to gear the drive axle up or down.	
The output (wheel) can be place on either side of the motor, and the motor can be inverted, depending on other building constraints. The L-shaped beam is required to keep the gears close together, so they will not slip, or skip teeth.	
## Gear Ratios	

This motor shaft will make1 rotation, in the same time the output shaft makes 1 Gears used:16 tooth on motor,16 tooth on output Gear Ratio: 1:1 Power: Same as motor Speed: Same as motor	
This motor shaft will make3 rotations, in the same time the output shaft makes 1 Gears used: 8 tooth on motor, 24 tooth on output Gear Ratio: 3:1 Power: 3x motor Speed: 1/3 x motor (slower)	
This motor shaft will make5 rotations, in the same time the output shaft makes 3 Gears used:12 tooth on motor,20 tooth on output Gear Ratio: 5:3 Power: 5/3x motor Speed: 3/5x motor (slower)	

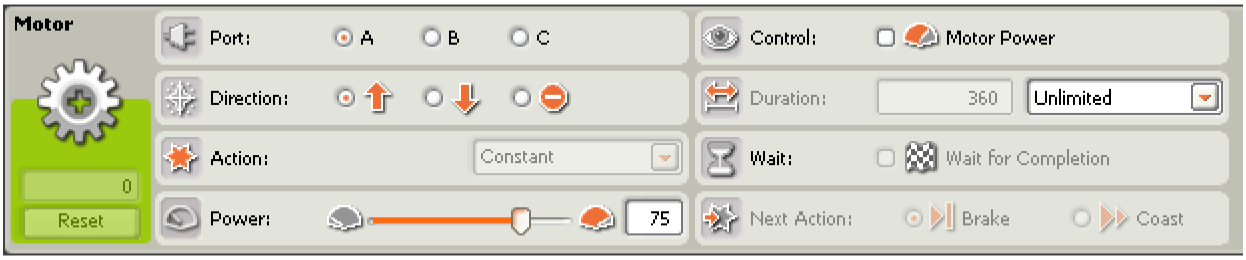
This motor shaft will make3 rotations, in the same time the output shaft makes 5 Gears used:20 tooth on motor,12 tooth on output Gear Ratio: 3:5 Power: 3/5x motor Speed: 5/3x motor (faster)	
This motor shaft will make1 rotations, in the same time the output shaft makes 3 Gears used:24 tooth on motor,8 tooth on output Gear Ratio: 1:3 Power: 1/3x motor Speed: 3x motor (faster)	

NXT-G "Unlimited" Move block does not work.

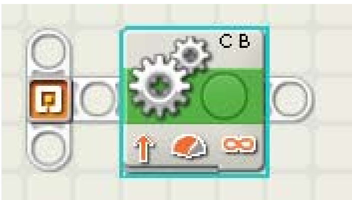
Q: I have an "Unlimited" move block inmy NXT-G program. The motor(s) run for a few seconds, then stop. WHY?

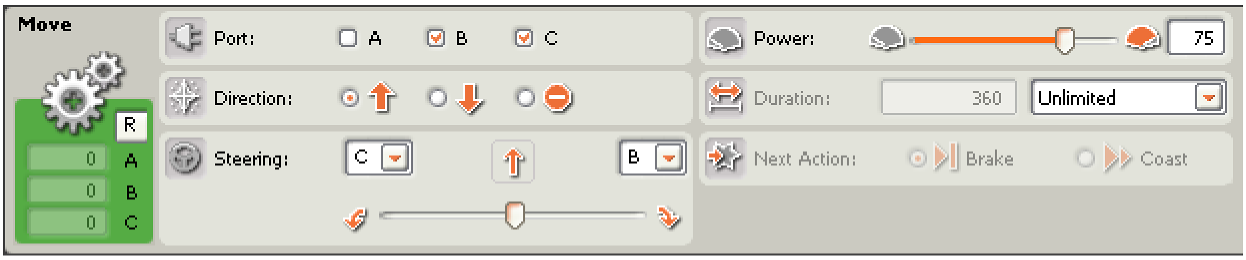
This question comes up all the time. It's not a bug in the software, hardware, or anything else. In fact, the software is doing exactly what it should.

It's very common for someone to write a program like this:



...or this:





...and, expect the motors to run forever.

However, the software has a nice feature where it will stop the motors when the program ends . And, very shortly after executing either of the above sequences, THE PROGRAM ENDS, at which point the motors are automaticallystopped.

SOLUTION:

Add something to the end of the program, so it will not stop...

Beginning Datalogging with the LEGO MINDSTORMS NXT --- Brian Davis

Preamble – Why I Bother.

On several occasions, people have asked me to help them with datalogging, so I thought I'd put this little guide together and put it on-line for the community. I'm choosing here to use NXT-G, because it's the environment that most people have access to for the LEGO NXT microcontroller (and one I have some experience with), but the ideas here are much more general. If you use a different language (RobotC, pbLua, NXC, etc.) or even a different platform (BASIC microstamp, RCX, etc.) many of the ideas are the same, just the implementation changes. And some of these languages offer advantages over NXT-G in speed or data manipulation as well, so please use whatever you choose

On a more personal note, I'm doing this because it's fun to explore the world around me, and I've found datalogging with the LEGO NXT amazingly easy (easy enough for a grade school student) yet powerful (enough that I've used it for high-altitude research on the edge of space). With a handful of relatively cheap sensors and the NXT brick, there are an almost unlimited number of things I can explore and learn – limited primarily by my imagination, not my pocketbook, and I can re-use the same equipment again & again, and know that others can repeat these investigations, without access to even a high-school science lab… just what they can get at a toy store and an on-line retailer or two.

What is Datalogging

The basic idea of datalogging is to run an experiment, but have a computer do the tedious data recording for you. For instance, if you wanted to know how the temperature changes during the course of an entire day, you could sit by a thermometer, carefully recording the temperature every five minutes on a sheet of paper, and then graph the results later… but it would be a huge amount of work. And in some cases you might want to learn about the conditions somewhere dangerous or inaccessible (does the light really go out in the refrigerator when you close the door?), or figure out what's happening in a process that's too fast to manually record (how fast does an incandescent light bulb turn on?). In all these cases you could use a microcontroller like the NXT to automate the process. In fact there are a number of commercial dataloggers available, for natural or industrial environments, but they tend to be either very specific (recording only a single specific sensor or two) or rather expensive (several hundred to several thousands of dollars). With the NXT, it's flexible, relatively inexpensive, and very common. There are a large number of simple sensors commercially available, and many books and websites can show you how to make your own custom sensors that are fairly easy to interface.

Some examples in the "real world" are monitoring the temperature & humidity of a museum showcase, or the water level in a river during a rainstorm. Dataloggers have also been used to monitor the accelerations experienced on roller coasters (an instrumented "test dummy" is sent through the ride before a human generally is), the eruption period of geysers in Yellowstone National Park (by recording the temperature of the runoff from the geyser), or the accelerations and gas consumption of a truck during its cross-country drive. Perhaps one of the best-known uses of dataloggers is an airplane's "black box" recorder. This is essentially a datalogger for all the critical systems of the plane: the positions of the control surfaces, airspeed, accelerations, and often many other sensors. All this can be used to try to reconstruct what happened during a flight (a variation on this was a datalogging device present on the Space Shuttle Columbia, that provided a huge number of measurements about the disaster when it was found, largely intact, on the ground).

Beginning Datalogging

A simple example of datalogging would be studying the light level in a room over a period of time. For instance, sometimes when you first turn on a florescent light it starts out slightly dim, and then gradually brightens over time. You can see this, but to determine how long it takes to reach “full brightness”, or how much it actually increases in brightness during the first few minutes is tougher to put a number on – and an easy, common thing to practice datalogging

If you were to do this “by hand”, you could just write down the measurement reported by the light sensor every second (or faster, if you could), and after a few minutes or so stop and graph the resulting data. The NXT can do the same thing, but instead it writes the information into a file in its memory. So we want a program that just Loops constantly (or for as long as we want it), reading the value of the light sensor and wiring that result into a File Access block. Here’s a program that reads the ambient light value from a light sensor once every second, and writes that result into a file named “DLog.txt”:

Fig 1-1: a minimal datalogging program. The Light Sensor block is configured to not generate light (uncheck the “Function” checkbox) and the File Access block is set to Write a number (not text) with a file name of “DLog”

{Link to Logger1.rbt}

Run this program in a dark room, turning on the lights after 10 seconds or so, with the light sensor pointed towards the lights. Let it run for about a minute, keeping the sensor stationary, stopping the program by hitting the “Cancel” button, (as the Loop is set to run forever, that’s the only way to have this program halt). After running this program, connect the NXT to the computer and look at the memory of the brick using NXT-G. If you select “other” from the bar chart on the left, a list of files will pop up, including the newly-created “DLog.txt”. By selecting this file from the list and clicking the “upload” button, NXT-G will transfer a copy of this file to your computer.

If you open this file in a word-processing program, you'll see a series of numbers, and if you open them in a spreadsheet program, you can graph these numbers and see exactly what the sensor reported each time it was recorded.

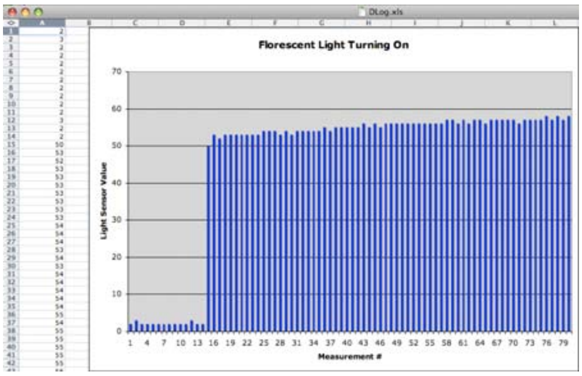


Fig 1-2: the series of numbers written to the "DLog" file, and a simple bar graph of the data. Each bar represents the light sensor reading for that second of the program run

That's the idea, but there is a lot of room for improvement. First it would be nice if the NXT also told us when it took the measurement, so we don't have to figure it out later and remember exactly what the interval was that we programmed into it. We could do that by reading a Timer, and combining that reading with the light sensor reading (separated by a comma) on each line. To do that we need to convert both numbers to pieces of text, and combine them with a comma between them before writing them to the file, but that's not too difficult:

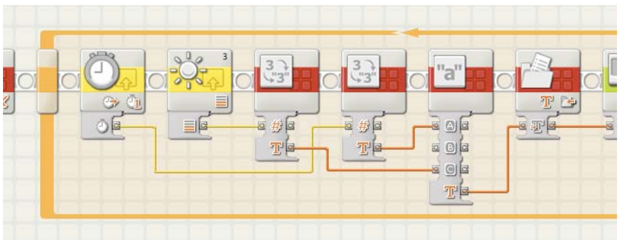


Fig 1-3: the same program, with a Timer block added, and the output of both blocks converted to text (in the first two red blocks) and then combined into one text string (in the third red block; the middle "b" field has a single comma entered into it in the configuration pane), and the result wired into the 'text' plug of the File Access block. Make sure the File Access block is now set to 'Text'.

And since we have all that information streaming into the NXTs memory, we might as well display it on the LCD so we know the program is running, and what it is “seeing”:

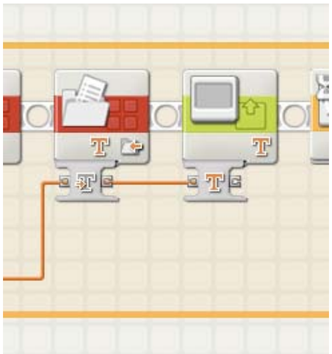


Fig 1-4: the same text that is sent to the File Access block is wired into a Display block (set to display text)

If we ran the original program a second time, we’d find that the new data just gets piled behind the old data. So for the 2nd version, put in two blocks at the start to close and delete any file with the name we’re going to be using (starting with a clean slate), and just to keep things neat a third block to close that file when the program ends (the NXT should do this for us when the program ends, but it’s a good habit):

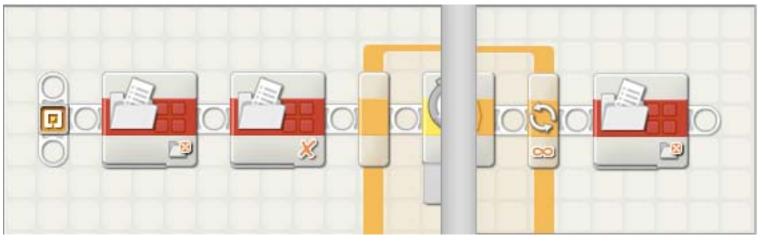


Fig 1-5: some File Access blocks, all with the “DLog” filename, to close, delete, and finally close the finished file.

And since the NXT is doing all the work for us, we might as well measure the light level much more frequently, so we’ll change the Wait block to only pause for 20 milliseconds, or 0.02 seconds between measurements (that’s a *lot* more measurements, but hey, the computer is doing all the work), and while we’re at it change the Loop so it exits when we hit the right arrow button (instead of Loop forever). The resulting program looks like this:

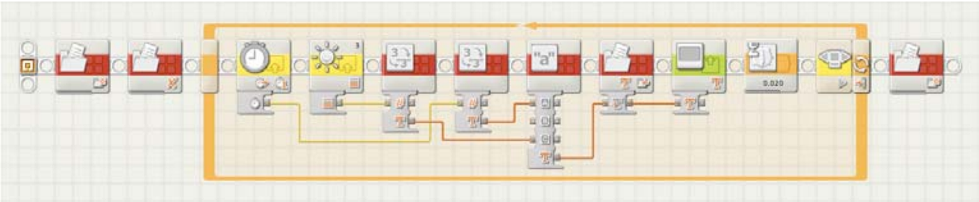


Fig 1-6: an entire datalogging program, stopped by the right arrow key

{Link to Logger2.rbt}

Run this program again in a dark room (preferably one with a “cold” florescent light that hasn’t warmed up recently), then connect to the NXT, select the file “DLog.txt”, and uploaded it to the computer. Now open the DLog.txt file on the computer with a spreadsheet (I use Excel, but almost anything should work). Many spreadsheets will automatically import this sort of file as “comma separated values”, but if not this can be forced (changing the extension to “.cvs” will often work, or you can specifically configure how the data is imported in a series of dialog boxes in Excel, for instance. The result is two columns of data, the first being the time reading (usually called a “timestamp”), and the second all the corresponding light sensor readings. Graphing these as an X-Y graph (using, for instance, the graph wizard in Excel), we’ve got a detailed record of “what the light sensor saw”:

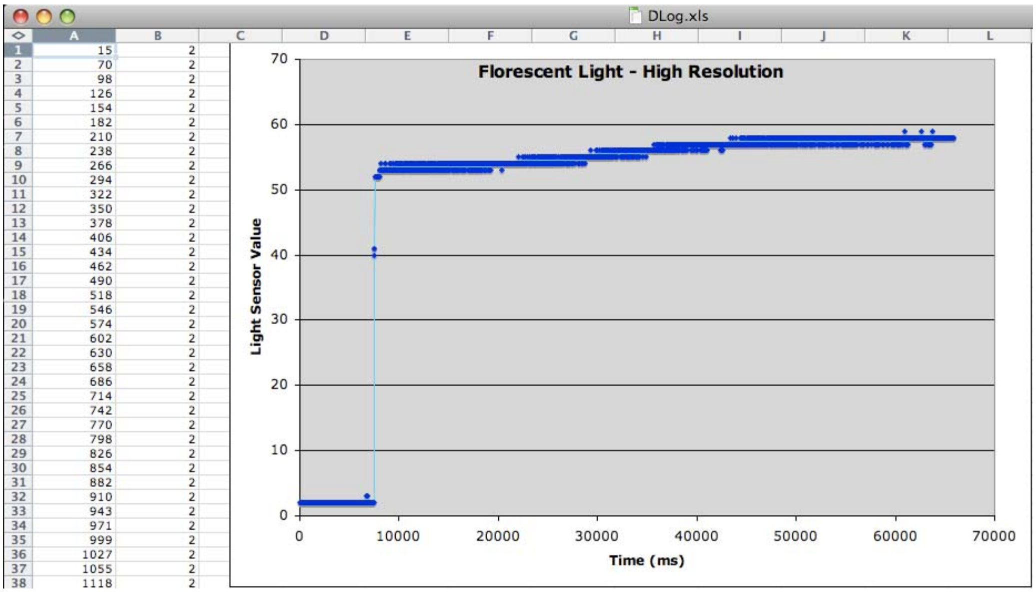


Fig 1-7: A high-resolution record of the light turning on

That looks great. For instance, I can now clearly see the lights getting slowly brighter, and see just how fast the lights turn on. But there are still a few problems. First if I look at the difference between the timestamps, the seem to be about 28 milliseconds, not 20 like we specified (and on rare occasions, there seem to be even longer pauses). The reason for that is simple: while the Wait block is waiting for 20 ms, there are other things going on in the Loop as well (such as sensor reading, formatting text, file writing), so one iteration of the Loop actually takes longer than just the time delay set on a simple Wait block. What we could do is replace the fixed Wait block with an inner Loop that only finishes when a 2nd timer exceeds the limit we set (say, again, 20 ms), and then right after that resets the 2nd timer to begin that "countdown" for when to do the next reading:

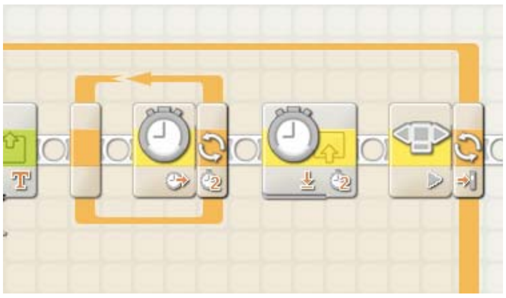


Fig 1-8: a Loop until timer #2 is greater than 0.02 seconds, followed by a block to reset timer #2

{Link to Logger3.rbt}

That works much better (the normal interval between records is now about 21 milliseconds, close enough). But looking at the data, on rare occasions the timing between readings is still larger that expected (in some cases, particularly if the program records a lot of data, a lot larger). These sort of unpredictable timing issues really make it important to timestamp the data in most situations. These odd “pauses”, by the way, are because the NXT doesn’t immediately write all the information to memory when you ask it to – instead, it usually waits until it has “enough” text ready to write, and does it all at once. The occasional very long pauses are due to the NXT having to move the entire file (copy it into a new portion of memory) because it ran out of room where the old file was growing. There are ways around at least the 2nd of these problems, but they are a little advanced – I only mention it so that people understand what’s happening, even if you’re not worried about it most of the time.

Other Basic Points & Tidbits

There are a few other things that we really have to think about with datalogging on the NXT. The first is how long you want to log – and keeping the NXT awake and alive that long. The NXT is usually set up to automatically turn itself off if a button isn’t pushed after a certain amount of time. If the NXT thinks it’s should shut itself off after 10 minutes, and you try to run a program unattended for an hour, you’ll return to find the NXT turned off and only about 10 minutes of data in the file. There are two solutions to this. First, you can navigate the NXT’s on-screen menu systems to set the sleep time to “never”. That will work just find, but if you ever forget to turn the NXT off when you’re done with it, you’ll find it has remained on until the batteries have been completely drained. A second solution is the Keep Alive block. This is a block that resets the “countdown timer” on the NXT, functioning the same way as a person pushing the button – a way to tell the NXT to remain awake (and running our datalogging program). All we need to do is make sure that the program occasionally executes a Keep Alive block as long as it is running; for instance, have one at the end of the main Loop:

Fig 1-9: The Keep Alive block inside the main Loop, so it is executed each time through

This solution has another advantage as well. As long as the program is running, it will keep the NXT “awake”… but once the program ends (perhaps, after your program has run for the desired amount of time), the NXT is free to "time out" and shut itself off, conserving whatever power source it was running on. This would be very handy if you were running on battery power, and don't want to just wear out batteries repeatedly on long-term projects.

This brings up the related problems of power-sources: conserving batteries is good, but for really long-term projects, normal batteries might not be enough (or, you might be tired of recharging or buying new ones constantly). If you have the LEGO Li-ion battery pack for the NXT and you are working indoors, you can plug the NXT into a wall outlet, running it from the house current and not from the batteries. This way you can continually acquire data for perhaps days or weeks at a time – without spending a fortune in replacing batteries*. Even if you don't use the Li-ion battery pack, normal fresh batteries can run the NXT for a very very long time, as long as it is not driving motors continuously. The more "mAhr" (milliamp-hours) a battery packs, generally the longer it will last; normally longer than 24 hours or more. In the only case I've fully documented, it took more than 50 hours of continuous datalogging to wear out one set of Energizer Lithium E2 AA's (these are also very light weight, and have amazing low-temperature performance… they will continue driving the NXT at temperatures far below freezing, for instance).

Another improvement that we could make is to have the code look a little better, and maybe be more reusable as well. Now that we have a program that can log a sensor value, we could probably just make a My Block that would function as a "Log Value" block, taking as an input something to write into the file, and adding the timestamp for us, perhaps even handling the timed wait. Turning all this into a My Block not only makes the program easier to understand, but it means the next time (in this program, or in some other) that we need to log some data, we have a known, tested, debugged way of doing it, and don't have to "reinvent the wheel" each and every time. Here's a very simple example called "EasyDL"; it uses a My Block named "Timestamp" to record a number that is wired into it to a file, taking care of all the formatting and details for you. It's not as accurate, or as flexible, as the first program we developed, but it shows an alternate way of doing it, and one that makes it extremely easy to put together a spur-of-the-moment datalogging program:

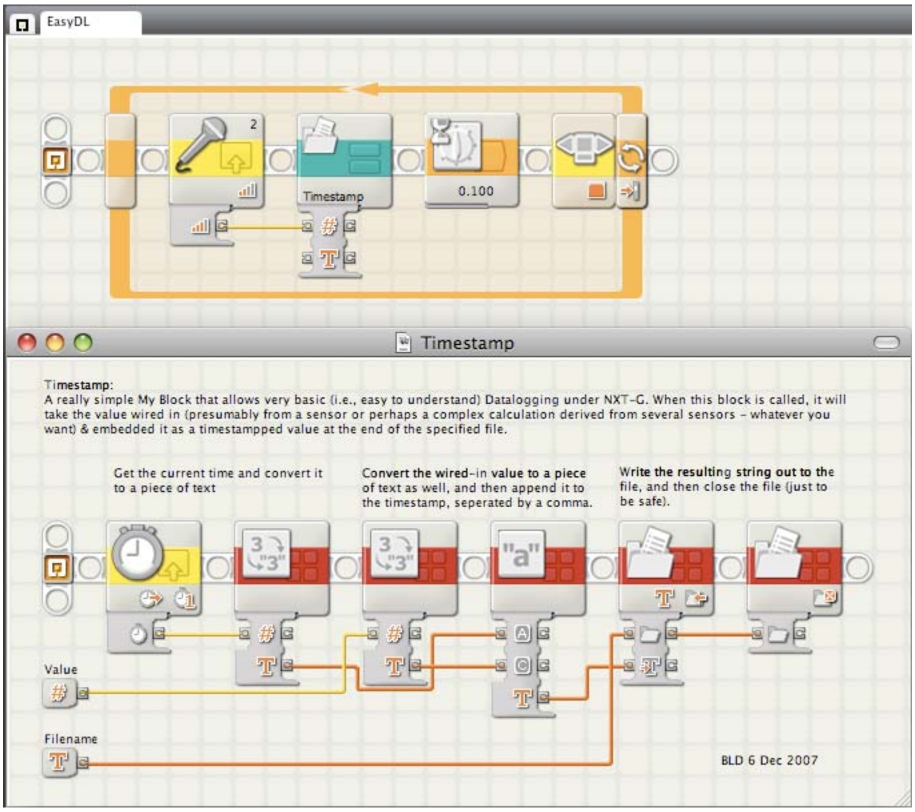


Fig 1-10: EasyDL, a very simple program that will log the sound sensor value using a My Block

Another thing this program demonstrates is that the file name to be used can be wired in as well, so that it could be changed from run to run, for instance… allowing one program to create different files like “Logfile1”, “Logfile2”, etc., instead of just always overwriting the one files). All that’s needed is a simple way for the user to adjust the file name (perhaps by adding a user-specified number that’s entered using the left and right arrow keys on the front of the NXT), and during one trip away from the computer (say, a visit to an amusement park) the user could take multiple files throughout the day, without having to download each and every one before taking a new one.

Finally, while this is all well and good, there are lots of other things to log than just the readings of a single light sensor. What if we wanted to log a sound sensor (say, to monitor noise levels in a school hallway)? Well, just replace the light sensor block with the sound sensor one, or whatever else we want to log: maybe a custom sensor, or a number calculated some other way. Of course we can also log more than one piece of data at each timestamp – the same way a comma was used to separate the time from the sensor in the file, another sensor could be added to the same line, just separated by another comma. That way, when we import the file into the spreadsheet program, it ends up with three (or more) columns, one for each piece of data. There's a lot of flexibility to take advantage of even with this very simple program. And the beauty of this method is that not only are you learning about the results of the datalogging, but by doing it yourself you end up understanding how datalogging works… as well as when it doesn't, and how you can change it to suit exactly what you want it to do.

*Note: some users have reported that the LEGO Li-ion battery packs have failed after having been plugged in for weeks at a time (but other users have had them function even after such use). In general, it might be a good idea not to just leave it plugged in continuously for months at a time, but I've personally had no problems… yet. You have been warned ☺.

Parting Thoughts

Why use the NXT? Seriously, there are some amazing datalogger from some very good companies that will do all this and much more. Commercial units can usually log much faster than the NXT, often much longer, and usually can store many more datapoints before filling their memories. In addition most commercial packages come with analysis software and are often smaller. Some of them are even cheaper than the NXT, and I've used and could recommend several from different companies. So why bother with the NXT?

First, the NXT gives a flexibility that's hard to match in such an inexpensive package. Not only can it interface with a fairly wide variety of sensors and record more than one input channel, but almost unheard of is the degree of control you have over what and how it is logging things. Any pattern of logging you want you can program – you are in no way limited to the way the manufacturer "thinks" it will be used. For "brainless" datalogging (taking a series readings at pre-set intervals) almost any off-the-shelf datalogger can be used. But with the NXT, a computer under your control, you can do "smart" datalogging. Log only when values are changing rapidly, or only when certain sensor are in certain ranges. Even control motors or lights or other outputs, depending on what the situation is. These are abilities almost no commercial dataloggers can match, and certainly nothing in the price range of the NXT.

Second, from the standpoint of education the NXT gives you a tool that is almost completely "transparent" to the student. Because the student has to program it, they need to understand what exactly the sensors are doing. Should we measure the instantaneous sensor reading, or the average? Or perhaps we want to record the maximum and minimum values and log those? Once we have the data, what does it mean? How do we convert the sensor readings to “real units” like accelerations in meters per second squared, or light levels compared to some known standard? What is the resolution or precision of the data, and how is that different from the accuracy? All these are critical questions to understand… and often they get glossed over because either the student is never forced to face them, or worse has no way to manipulate them (is the commercial datalogger recording the average readings, or the instant-by-instant readings? Or something else? Often, the user doesn’t even know). With the NXT you have a tool that is “open” to the student (and teacher!) in a way a commercial unit isn’t. The NXT isn’t just a way to produce some data for analysis – it’s a way to understand how that data is obtained. And in an educational setting that is far more important than “just the numbers”.

Simple Windows Bluetooth Remote

Pretty early on, I made a pretty simple Windows application, that could control an NXT over Bluetooth. I really haven't done much with it, but someone just asked me about it, so I figured I'd post it.

There aren't many instructions. There is a very narrow button to the left of the "C" motor button. And, another appears between the B & C motors.

Also, there are keyboard commands to run the motors. I think it's Q/A, W/S, & E/D.