ADVANCED EV3 PROGRAMMING LESSON

Gyro Sensor Revisited

By Sanjay and Arvind Seshan

Lesson Objectives

1. Learn about how older and newer generations of gyro sensors effect the calibration process
2. Learn how to how to deal with gyro drift with this updated information about the gyro sensor.

Prerequisites: Data wires, Loops, Logic & Comparison Blocks, Introduction to Gyro

Terms to Know

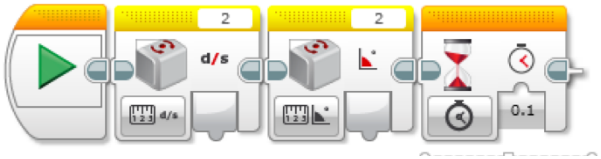
- Reset: Current value of the gyro sensor angle is set to “0”. This is what the gyro block with mode set to “reset” does.
- Calibration: The gyro calibrates what it considers to be “still”. This sets both the current gyro sensor rate and angle to “0”. This typically occurs when the gyro is connected.
- Some people refer to calibration as a “hard reset”. We will call this calibrate through this lesson to reduce the amount of confusion.

Why Revisit the Gyro?

- It has been brought to our attention by Mr. Sam Last from North Carolina that certain gyros are acting differently.
- On certain gyro sensors, the commonly used calibration code for the gyro (switching between angle and rate), does not work (i.e. does not cause the gyro to perform a recalibration).
- This is an big issue for anyone using one of the gyro sensors that does not recalibrate with this code.

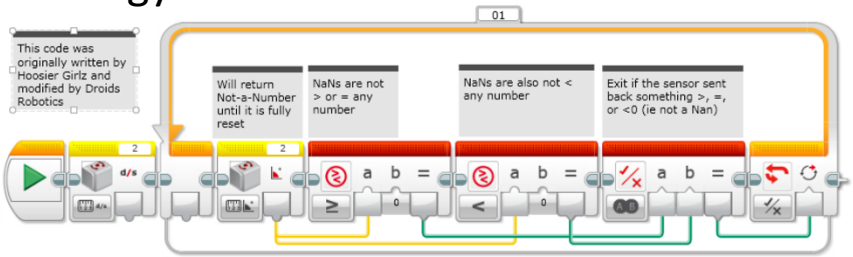
Reset Methods from "Introduction to Gyro"

Strategy 1:

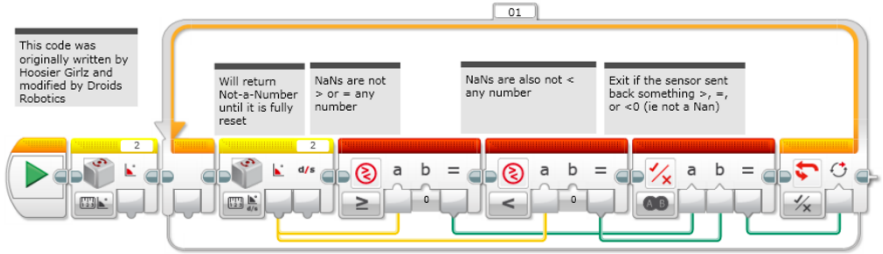


Strategy 2:

Strategy 3:



Strategy 4:



Testing the Gyro Sensors

- We obtained data from 12 gyro sensors from various years (purchase year some time between 2013-2016)
- Strategy 4 code (from Introduction to Gyro Lesson) provides a simple way to test if you have a sensor that supports recalibration or not.
  - On sensors that perform the recalibration, it takes 3 seconds to run this code.
  - On sensors that do not perform the recalibration, the code runs in < .1 seconds.
  - We added some timer code to test a gyro sensors by running three recalibrations and averaging to see how long they take.
  - We thought the problem may be related to the numbers on the bottom of the gyro (shown in red circle) – so, we recorded this as well.

Results

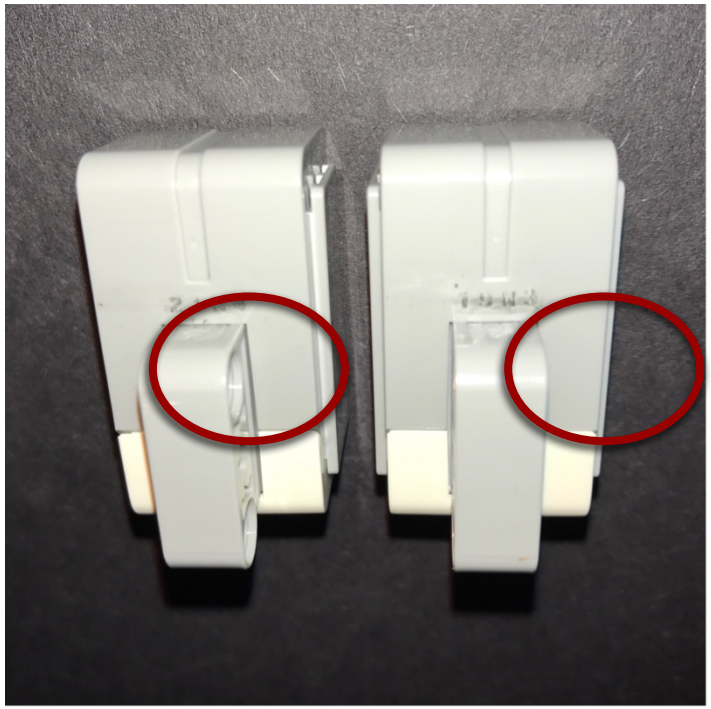
- There is a correlation with the numbers printed on the gyros themselves and whether or not they recalibrate correctly.
- All gyro sensors ending in “N3” worked. All gyro sensors ending in “N4” did not work.
- There are 7 numbrers on the charts although we have data for 12. This is because the numbers are repeated on some of the sensors (not unique numbers).

Recalibration Worked	Recalibration Did Not Work
03N3	20N4
19N3	21N4
04N3	38N4
	39N4

- *Note: If you complete this lesson and discover new numbers to add to the list, please email them to us at team@ev3lessons.com.*

What Sensor Version Do You Own?

- Method 1: You can look for the tiny number printed on the gyro sensors and look at the last two digits
- Method 2: You can run the test code we have provided for you on EV3Lessons and it will tell you which sensor you have and if the traditional recalibration or an alternative recalibration method is needed.



What if You Own an "N4" Sensor?*

Hardware Solution

- Unplug and re-plug your gyro sensor while making sure your robot is still
- This technique requires access to the EV3 ports and is prone to failure since you may shake the robot as you re-plug the wire.

Software Solution

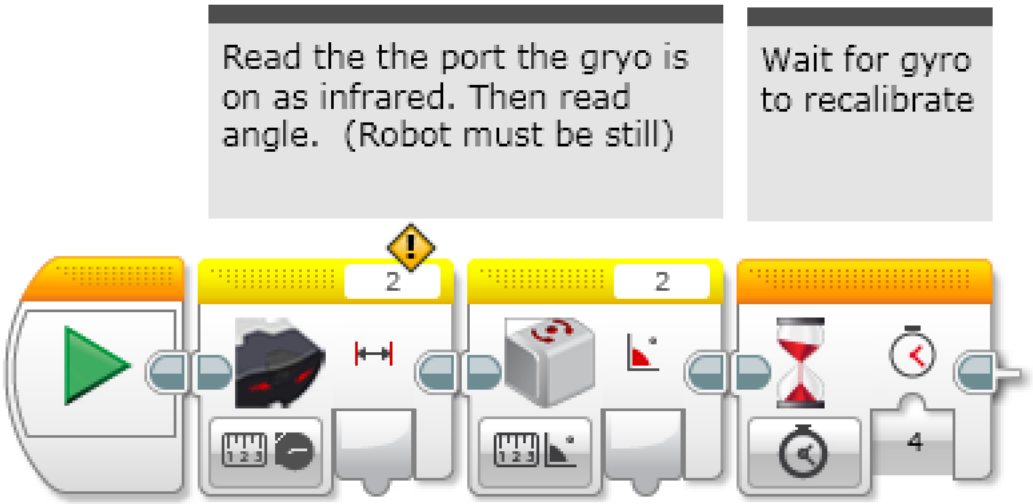
- If you read the port the gyro is connected to as an infrared sensor and then read it again as a gyro sensor, it seems to force a recalibration of the gyro.
- See the next 4 slides for updated recalibration code for the "N4" sensor. (Can be used with "N3" as well.)
- Note: Did not work reading the sensor as color, ultrasonic, touch or temperature.

** As we discover more solutions, this slide will be updated.*

Recalibration Strategy 5

First, reading the gyro as an IR sensor and then as a gyro causes the gyro to recalibrate.

Second, add a wait block to give the sensor a bit of time to fully recalibrate. Our measurements show that 4 seconds is safe. Note that the Strategy 1 code in Intro to Gyro, recalibration only took 0.1 seconds.



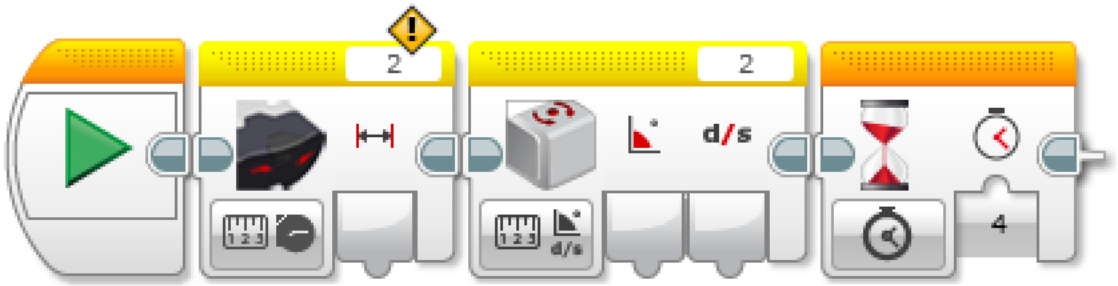
Note for "N3" sensor users: in the rest of your program, you should only use the "angle" modes of the gyro. Using the "rate" or "rate and angle" mode will cause the gyro to recalibrate. "N4" sensor users can change modes without causing a recalibration. Mode changes do "reset" the angle to 0.

Recalibration Strategy 6

This version of the calibration leaves the gyro in rate+angle mode. This is useful for “N3” users if you use the rate output.

This version takes a little bit longer (4 vs. 3 seconds) than the Strategy 2 code in Intro to Gyro.

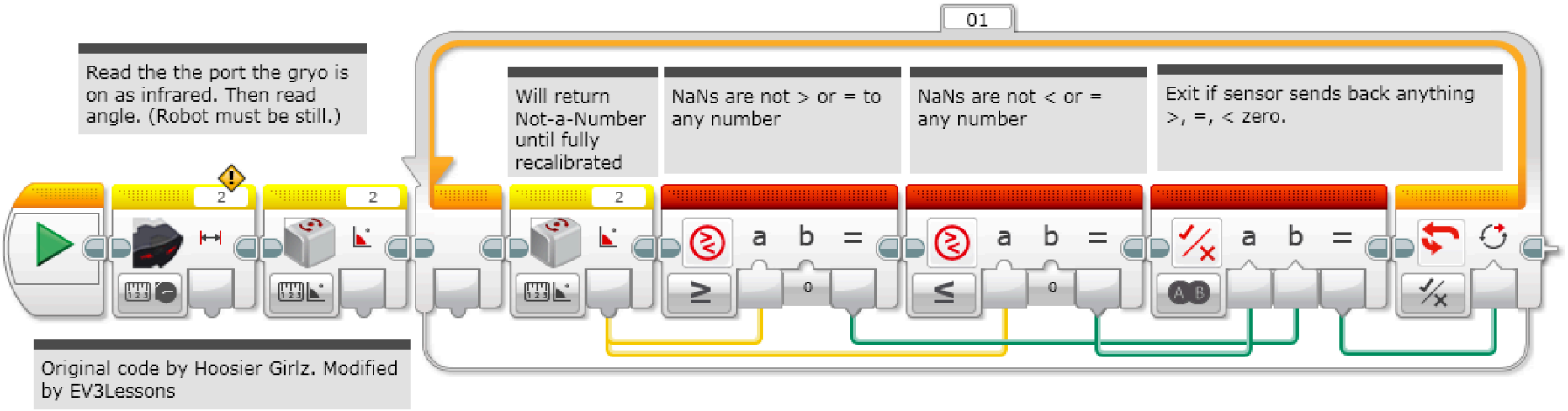
Note for “N3” sensor users: in the rest of your program, you should only use the “rate + angle” modes of the gyro. Using the "angle" or “rate” mode will cause the gyro to recalibrate. Also, ***DO NOT*** use the gyro reset mode - this forces the gyro into angle mode which will cause a long 3 second recalibration. “N4” sensor users can change modes without causing a recalibration. Mode changes do “reset” the angle to 0.



Read the the port the gryo is on as infrared. Then read rate and angle. (Robot must be still.)

Wait for gyro to recalibrate

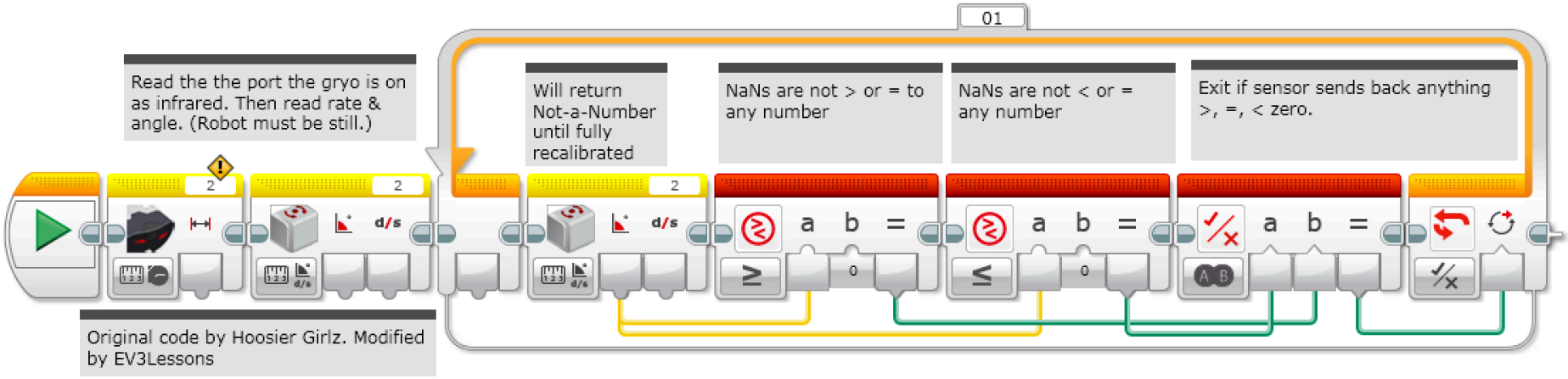
Recalibration Strategy 7



This version of the calibration leaves the gyro in angle mode. This is probably the most common way to use the gyro. This code takes about 4 sec to run (vs. 0.1 sec for the Strategy 3 code in Intro to Gyro)

Note for "N3" sensor users: in the rest of your program, you should only use the "angle" modes of the gyro. Using the "rate" or "rate and angle" mode will cause the gyro to recalibrate. "N4" sensor users can change modes without causing a recalibration. Mode changes do "reset" the angle to 0.

Recalibration Strategy 8



This version of the calibration leaves the gyro in rate+angle mode. This is useful for “N3” users if you use the rate output.

Note for “N3” sensor users: in the rest of your program, you should only use the “rate + angle” modes of the gyro. Using the "angle" or “rate” mode will cause the gyro to recalibrate. Also, ***DO NOT*** use the gyro reset - this forces the gyro into angle mode which will cause a long 3 second recalibration. “N4” sensor users can change modes without causing a recalibration. Mode changes do “reset” the angle to 0.

Discussion

- The new gyro calibration strategies in this lesson work for either the "N3" or "N4" sensors
- Note that all the new recalibrations take about 3-4 seconds. This is significantly more than the previous strategy 1 and 3 (in the Intro to Gyro lesson) which left the gyro in angle reading mode (0.1 sec vs. 3-4 secs)
  - Therefore, if you have an older "N3" gyro, you might want to use the old code that took less time to recalibrate.
- The newer "N4" sensors allow you to use different gyro modes inside a program without causing a recalibration.
- *Note: it seems that there was a hardware change between the "N3" and "N4" gyro. If you take apart your gyro, we would love to get pictures and details.*

Credits

- This tutorial was written by Sanjay Seshan and Arvind Seshan
- More lessons at www.ev3lessons.com
- Thank you to Mr. Sam Last for first reporting this issue to us.