ADVANCED EV3 PROGRAMMING LESSON

Introduction to Gyro Sensor and Drift

By Sanjay and Arvind Seshan

Lesson Objectives

1. Learn what the Gyro Sensor does

2. Learn about 2 common problems with using the gyro sensor (drift and lag)

3. Learn what "drift" means

4. Learn how to correct for drift with a gyro "calibration" technique

5. Learn about how older and newer generations of gyro sensors effect the calibration process

Prerequisites: Data wires, Loops, Logic & Comparison Blocks

What is the Gyro Sensor?

↗ Gyro sensor detects rotational motion

↗ The sensor measures the rate of rotation in degrees per second (rate)

↗ It also keeps track of the total rotational angle and therefore lets you measure how far your robot has turned (angle)

↗ The accuracy of the sensor is ±3 degrees for 90 degree turn

Gyro Sensor Problems

↗ There are 2 common Gyro issues – drift and lag

    ↗ Drift – readings keep changing even when the robot is still

    ↗ Lag – readings are delayed

↗ In this lesson, we focus on the first problem: drift.

    ↗ We will cover lag in the Gyro Turn lesson

↗ Solution to drift: gyro calibration

    ↗ The source of the drift problem is that the gyro must "learn" what is still.

    ↗ For a color sensor, you have to "teach" the robot what is black and white

    ↗ For your gyro, you need to calibrate the sensor to understand what is "still"

Gyro Calibration to Solve Gyro Lag

- The gyro auto-calibrates when the robot is turned on or the gyro wire is connected. If the robot is moving during calibration, the gyro "learns" the wrong value for "still" – this causes drift!

- Unfortunately, there is no gyro calibration block. There a few ways to make the sensor recalibrate.

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.

Different Generations of Gyro Sensors

↗ We discovered that there were two different generations of gyro sensors. Sensors made on of before 2013 and sensors made after that.

↗ We did extensive testing on both types of sensors with the help of the extended MINDSTORMS community and discovered that there was a hardware change between 2013 and 2014.

↗ As a result, the commonly seen gyro sensor calibration techniques out there do not work on all gyro sensors. Be careful using code you may find online as it may no longer work on newer gyro sensor

Only Reliable ways to Calibrate the Gyro

Hardware Solution

↗ Unplug and re-plug your gyro sensor while making sure your robot is still

↗ But, 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.

↗ This solution works reliably on any generation of sensor.

EV3Lessons.com provides Gyro Drift Test code for EV3-G.

Important Notes for Success

- <u>Keep the robot still</u> when you calibrate the gyro

- You <u>should not have not have to run this every time</u> you need to read the gyro

- You should <u>calibrate in a separate program</u> and run it once before you run your code

KEY CODE COMPONENTS

- Reading the Gyro Sensor port as Infrared and then reading as a Gyro Sensor will cause the Gyro Sensor to reset

- While it is resetting, the gyro will return a special value called Not a Number (NAN).

- Comparing to see that reading is a valid number makes sure that your calibration is completed. If the reading is Not a Number (NAN), it should return false.
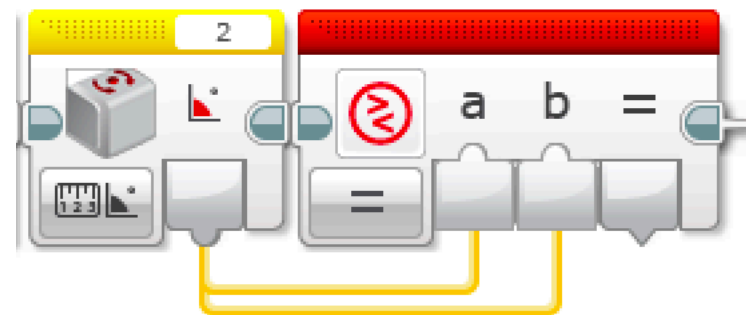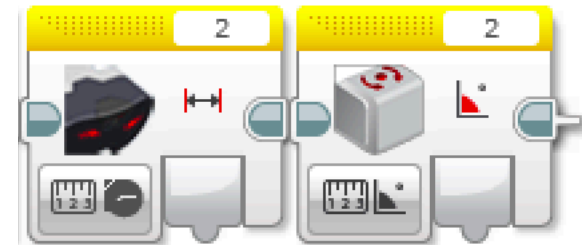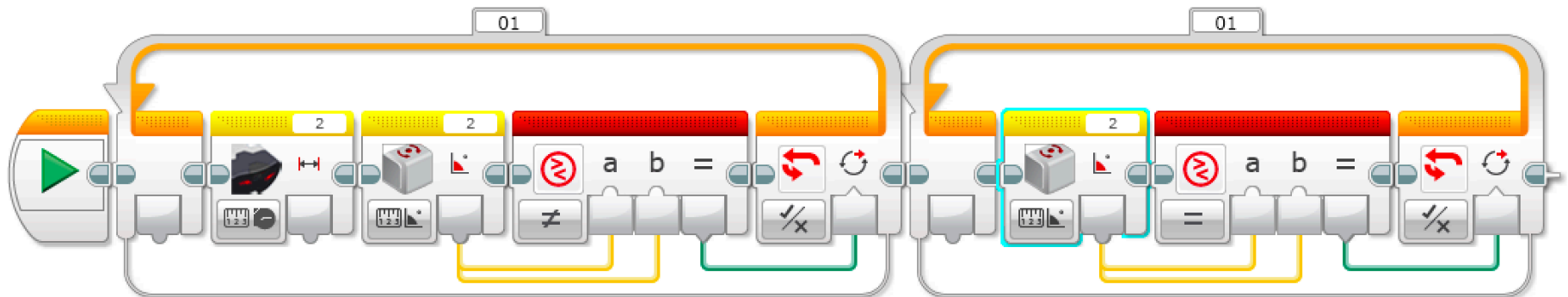
Gyro Calibration Code

This calibration code will work on all Gyro Sensors (regardless of what year they were made in)

- Read the Gyro Sensor port as Infrared and then read as a Gyro Sensor to cause Gyro Sensor to reset
- Wait until the gyro reads Not a Number (NAN) to ensure it is resetting

- Wait until the gyro reads a normal number to determine that the reset is complete

Gyro Rate and Rate & Angle Modes

↗ Note that in the rest of your program, you should only use the "angle" modes of the gyro. Using the "rate" or "rate & angle" mode will cause older versions of the gyro to recalibrate.

↗ If you want to use these modes of the gyro, we recommend that you use the use the "Rate & Angle" mode block in the calibration code and only use "Rate & Angle" blocks in your program

Discussion Guide

1. **What are 2 common problems when programming with the gyro?**

    Ans. Gryo drift and Gyro lag

2. **What does Gyro drift mean?**

    Ans. The Gyro readings keep changing even when the robot is still

3. **Can you move your robot when you calibrate your gyro?**

    Ans. No!! Keep the robot still.

4. **Do you need to calibrate your gryo before every move?**

    Ans. No. Once before you run your entire program

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.

↗ Thank you to David Lechner for investigating and discovering the hidden modes of the newer sensor.