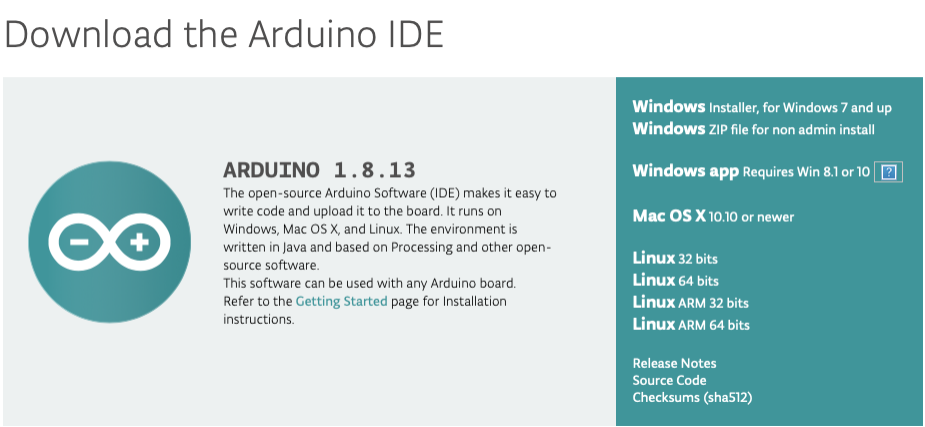
Balancing Robots
guide for the hands-on experiences

Table of contents

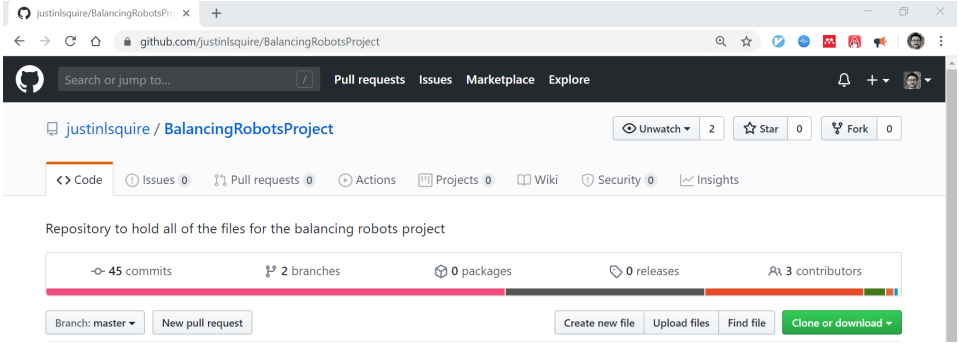
Instructions for installing the software: Arduino IDE

If you have not done so yet, download and install the latest Arduino IDE from `https://www.arduino.cc/en/Main/Software`,
it should look like this:



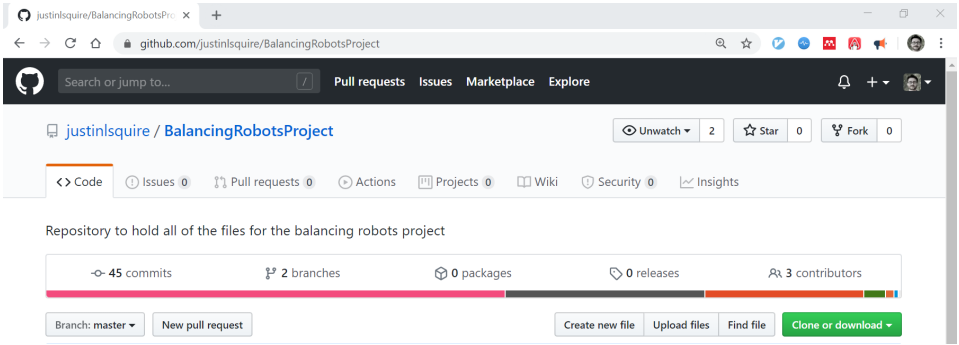
Instructions for installing the software: Balancing Robot Project Software

go to `https://github.com/justinlsquire/BalancingRobotsProject`,
it should look like this:



Instructions for installing the software: Balancing Robot Project Software

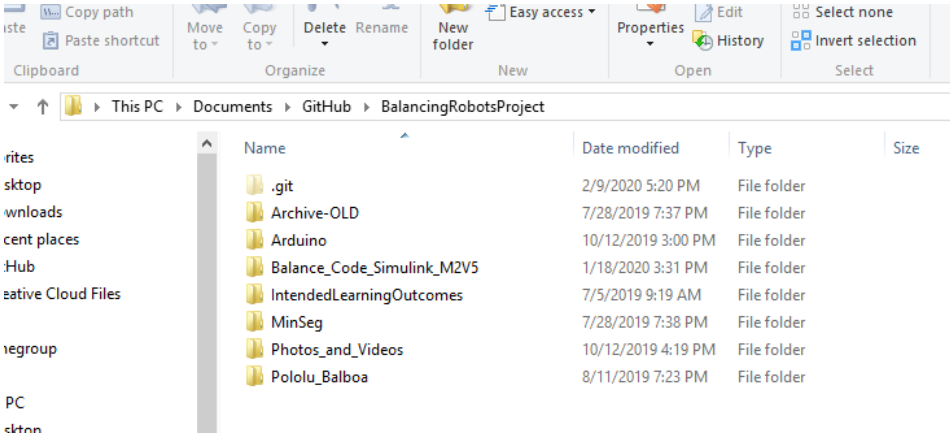
download the software by clicking the “clone or download” button:



in any folder you prefer, then unzip the downloaded file

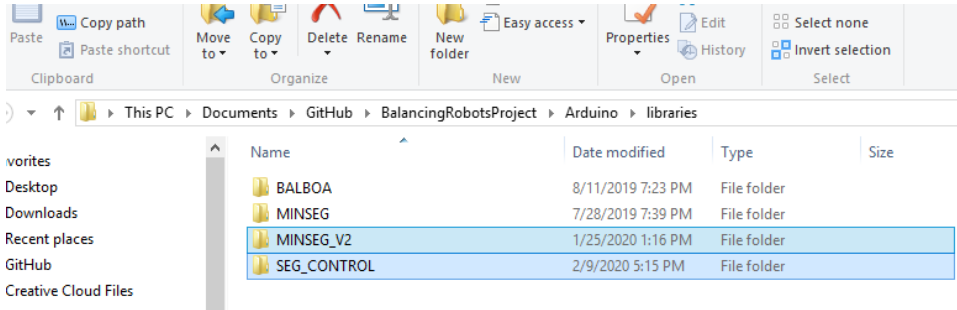
Instructions for installing the software: Balancing Robot Project Software

open the unzipped file (sometimes called also “repository”) in your file explorer:



Instructions for installing the software: Balancing Robot Project Libraries

go to the “Arduino” folder, then the “libraries” folder, then highlight and ***copy*** the two folders called “MINSEG_V2” and “SEG_CONTROL”:



Instructions for installing the software: Balancing Robot Project Libraries

go to your Arduino Libraries folder (note that the default location for Windows is `Documents` ↦ `Arduino` ↦ `Libraries`) and paste the two folders there

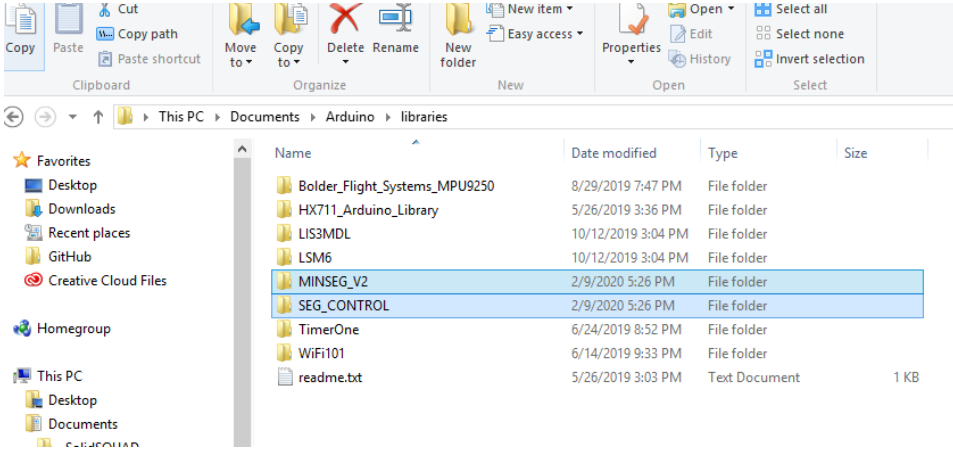


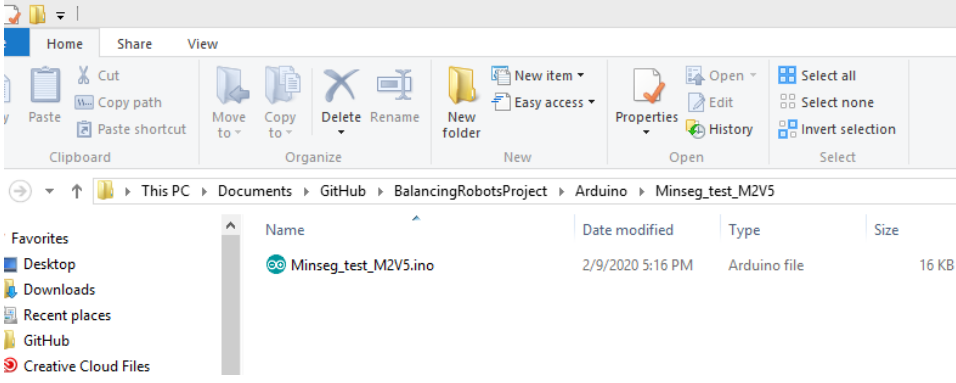
Table of contents

Connecting the robot: Connect the cable

- Use the usb cable to connect the robot to your computer.
- Add six AA batteries to the back.
- Switch “Driver Enable” at the top left corner to “off”.

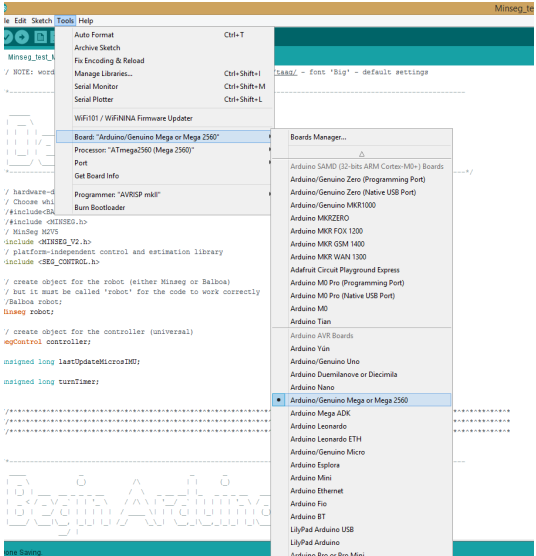
Connecting the robot: Open the file

Go back to the GitHub repository folder `BalancingRobotsProject` ↦ `Arduino` ↦ `Minseg_test_M2V5`, and then open the "Minseg_test_M2V5.ino" file in Arduino



Connecting the robot: Select the board

Go to `Tools` ↦ `Board` and select “Arduino/Genuino Mega or Mega 2560”



Connecting the robot: Select the port

Go to `Tools` ↦ `Port` and select the COM port associated with the MinSeg you plugged in via the USB port (If you unplug the MinSeg and check this Port field again, you should see one missing... This is the port that you should select when you plug back in the MinSeg.)

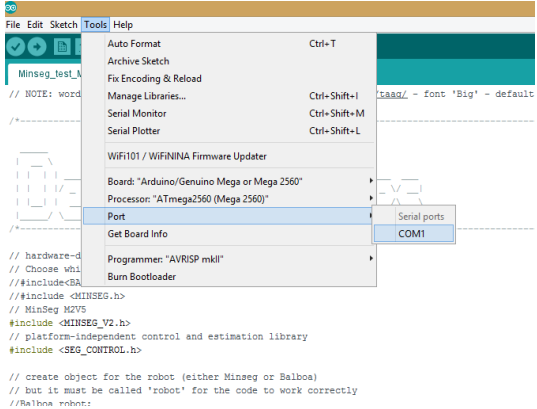


Table of contents

Calibrating the sensors: First step: raw offset

Uncomment line 214 (or search for the line in case it has moved) so that it reads `Serial.println(robot.getGyroXAvg());` (without // !!)

```
210  controller.updateEstimator();
211
212  // temporary stuff for debugging
213
214  Serial.println(robot.getGyroXAvg());
215  //Serial.println(robot.gx*57.4);
216  //Serial.println(robot.getOrientationOffset());
217  //Serial.println(controller.ex*57.4);
218
```

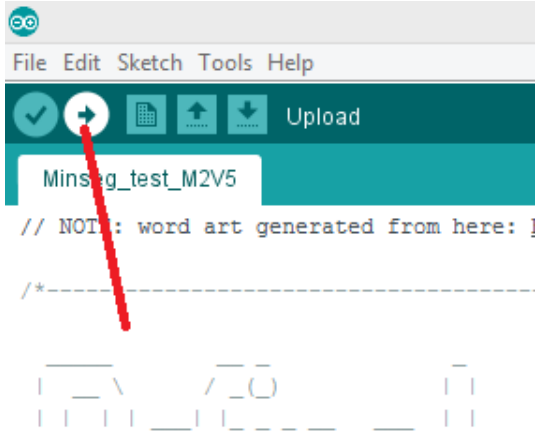
This will ensure that the ra data of the gyroscope can be read.

Calibrating the sensors: Put the Minseg down

Put the Minseg onto a flat surface and let it lay still.

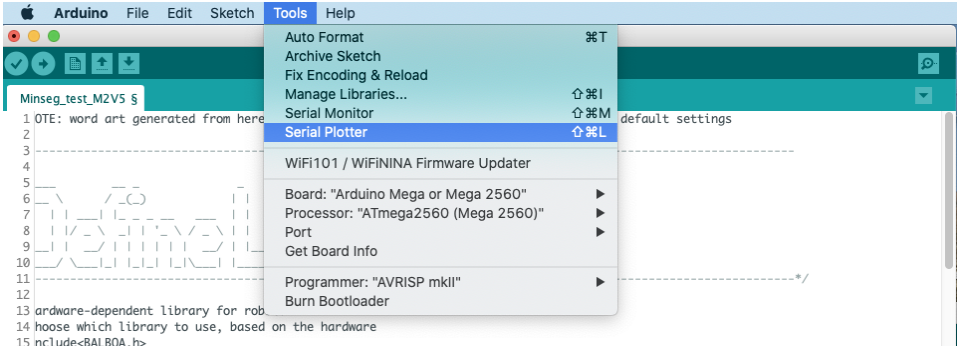
Calibrating the sensors: Upload the code

Click the “Upload” button to load the code to the MinSeg



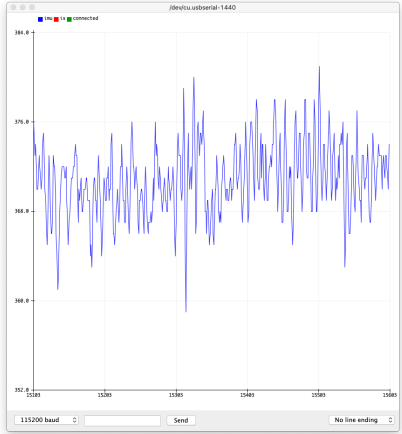
Calibrating the sensors: Open the Serial plotter

Open the serial plotter by selecting the appropriate item in Tools.



Calibrating the sensors: Observe the raw measurement

Make sure that the Minseg is laying absolutely still. Observe the values and note down the average value. Simply observing the curve should be enough.



In this case here, the average is roughly 372.

Calibrating the sensors: Set the raw offset

Comment line 214 again so that it reads
`//Serial.println(robot.getGyroXAvg());`.
Set the raw offset in line 75 to your average value. For instance, in our example, it is 372:

```
73  // set these based on the true observed values from the sensors
74  // instructions will be done soon
75  robot.gx_raw_offset = 372; // gyro offset in raw units
76  controller.orientationOffsetX = -1.62; // vertical (balancing) orientation offset in radians
77
```

Calibrating the sensors: Second step: orientation offset

Uncomment line 216 (or search for the line in case it has moved) so that it reads `Serial.println(robot.getOrientationOffset());` (without // !!)

```
214  //Serial.println(robot.getGyroXAvg());
215  //Serial.println(robot.gx*57.4);
216  Serial.println(robot.getOrientationOffset());
217  //Serial.println(controller.ex*57.4);
```

Calibrating the sensors: Observe the orientation offset

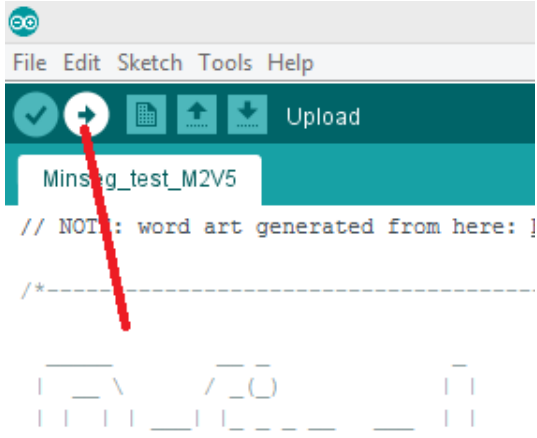
Similar to observing the raw offset,

- Upload the code to the Minseg.
- Open the serial plotter.
- Hold the Minseg carefully between your finger tips so that it balances!!
- Observe the value when the robot is still and balances and note the average value.
- In line 76, set `controller.orientationOffsetX` to the value you observed.
- Comment line 216 again.

Table of contents

Running the software: Upload the code including your calibrated values

Click the “Upload” button to load the code to the MinSeg



Running the software: See the robot balance!

Hold the Robot upright and make sure the switches are set to “ON”, “BATT”, and “ON” from the top down - the robot should start balancing if everything went well!