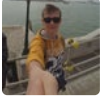


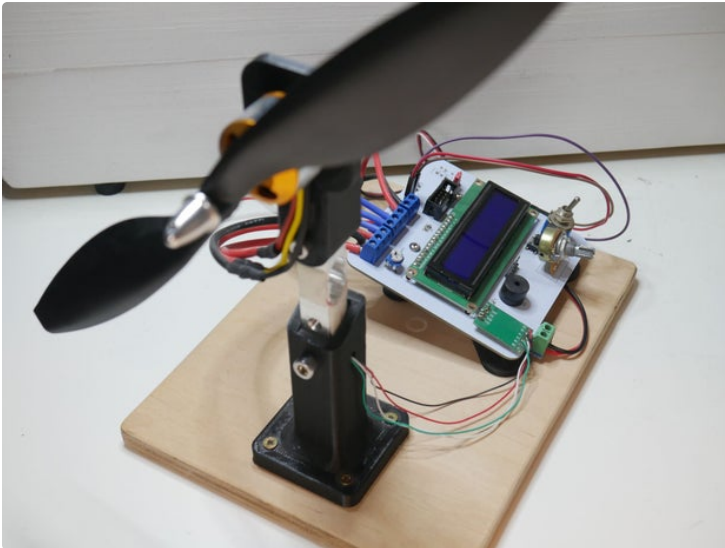
Brushless Motor Thrust Stand



by Nikus

Back in the time when I was building my Arduino based Ludwik Drone I faced a problem of choosing proper motors and propellers. I didn't know anything about drones at that time so I had to trust motor manufacturer and the datasheet of a motor those are most likely to be a good source of information but what if you want to combine different motors and propellers together? You still need to know the thrust of the motor and propeller, golden rule for drones is to have at least 2 times bigger thrust than weight of your drone (it depends on what type of drone you want to build this rules doesn't work

for racing/acrobat drones and some other). I thought that there must be a device for measuring thrust of a motor, I found some online but those were really expensive so an obvious decision for me was to design my own! I found some time during my internship at CIT (I was working on airfoil design and testing for a VTOL drone here, that was very cool!) to design a PCB without prototyping and any of the parts, just online datasheets. Surprisingly PCB work just fine! If you want to test your motors keep reading!



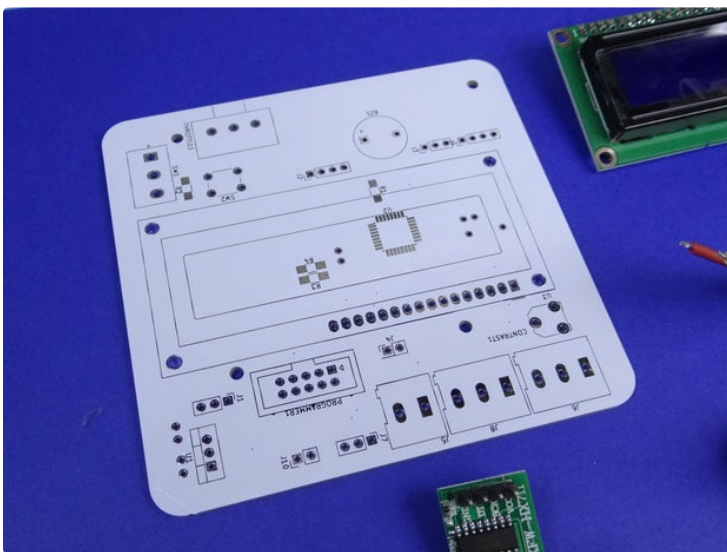
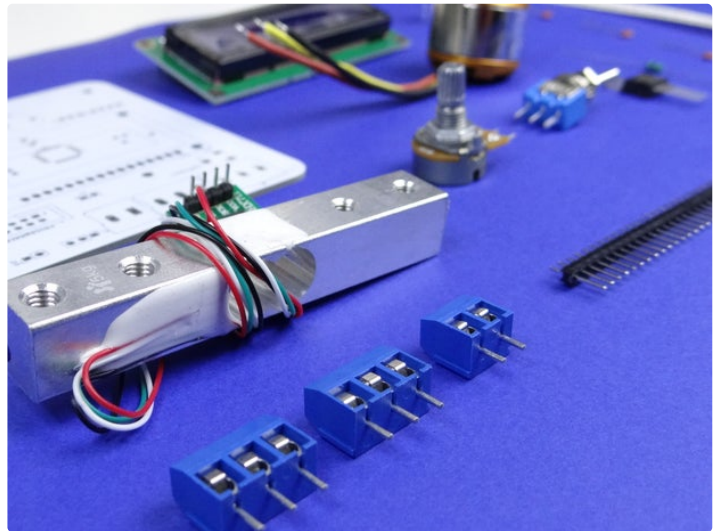
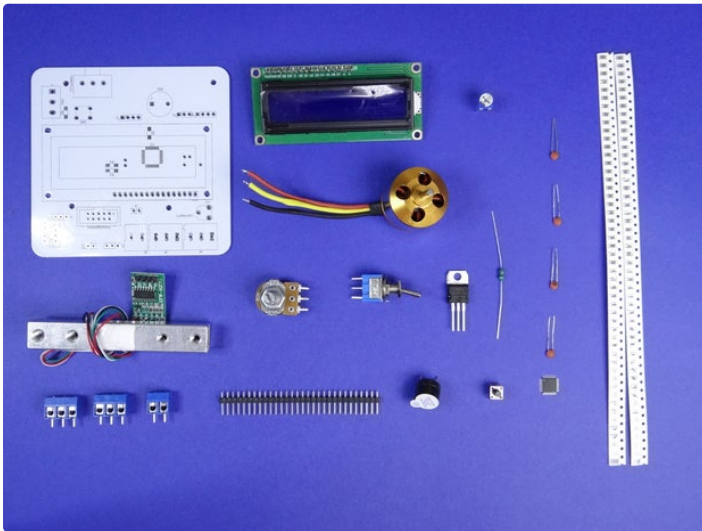
https://www.youtube.com/watch?v=Y8D_425aGxM

Step 1: Parts

We will need components that are listed below, check out values of them on the schematic:

- Tensometric beam (also called load cell or strain gauge)
- 16x2 LCD

- Motor + ESC + propeller
- Current sensor
- Buzzer
- 2 pin screw terminal
- 3 pin screw terminal
- Potentiometer
- Switch
- Breakaway Headers
- potentiometer
- Kanda socket
- Some SMD resistors
- Atmega328 SMD
- Some ceramic capacitors
- Choke
- PCB

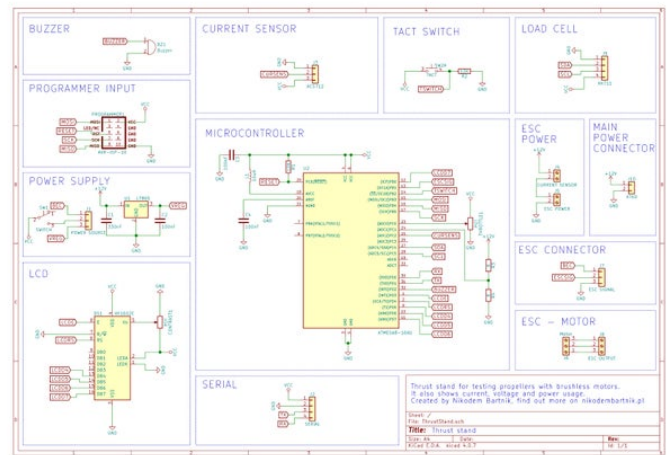
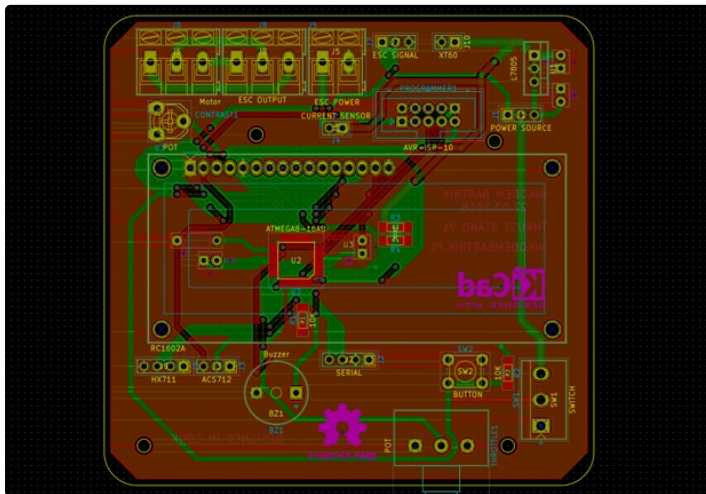


Step 2: PCB

I spend a lot of time on the design of the PCB, I wanted to make it as perfect as I could and it turned out quite nicely! At least it looks more professional than my other PCBs :D Above you can find files to make your own PCB. There is also schematic if you want to build it on a breadboard or protoboard (you can do it without any problem). There is a lot of things I add to the PCB because after analyzing it I thought it will be easier to use. For example, I added screw terminal to connect motor and ESC so if you want to test another motor you don't have to unsolder it. There are also more

components than I am actually using (I don't use voltage regulator because I am using Battery Eliminator Circuit (BEC) build in to Electronic Speed Controller (ESC). There is also a switch and button that I am not using but maybe you would like to change a code or add some functionality.

https://www.pcbway.com/project/shareproject/Brushless_motor_thrust_stand_with_Arduino.html



<https://www.instructables.com/ORIG/FO3/CCC3/JPINX5WQ/FO3CCC3JPINX5WQ.pro>

Download

<https://www.instructables.com/ORIG/FIK/A6ND/JPINX5ZL/FIKA6NDJPINX5ZL.sch>

Download

<https://www.instructables.com/ORIG/F4A/8WE7/JPINX6NZ/F4A8WE7JPINX6NZ.gbr>

Download

<https://www.instructables.com/ORIG/FMV/8L4I/JPINX6VI/FMV8L4IJPINX6VI.net>

Download

<https://www.instructables.com/ORIG/FYI/F8P1/JPINX6AW/FYIF8P1JPINX6AW.gbr>

Download

<https://www.instructables.com/ORIG/FNI/1L71/JPINX63D/FNI1L71JPINX63D.gbr>

Download

<https://www.instructables.com/ORIG/FKC/1MB6/JPINX61H/FKC1MB6JPINX61H.gbr>

Download

<https://www.instructables.com/ORIG/FB2/ZLMR/JPINX675/FB2ZLMRJPINX675.gbr>

Download

<https://www.instructables.com/ORIG/FFV/L8HD/JPINX6ID/FFVL8HDJPINX6ID.gbr>

Download

<https://www.instructables.com/ORIG/FAD/8Z5V/JPINX6TL/FAD8Z5VJPINX6TL.gbr>

Download

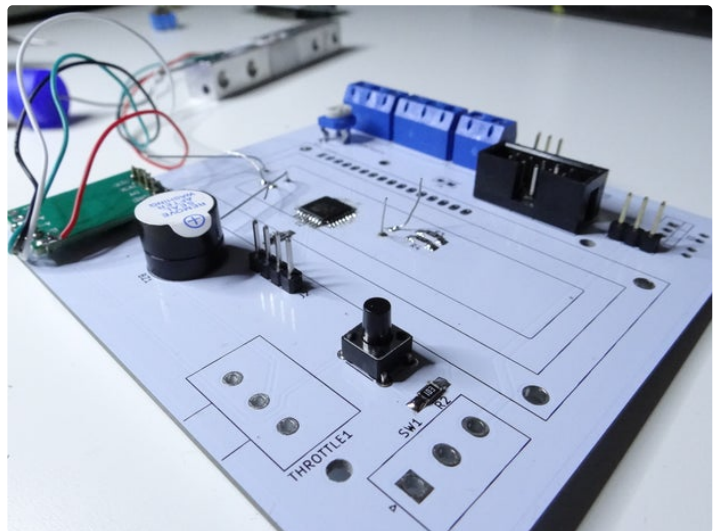
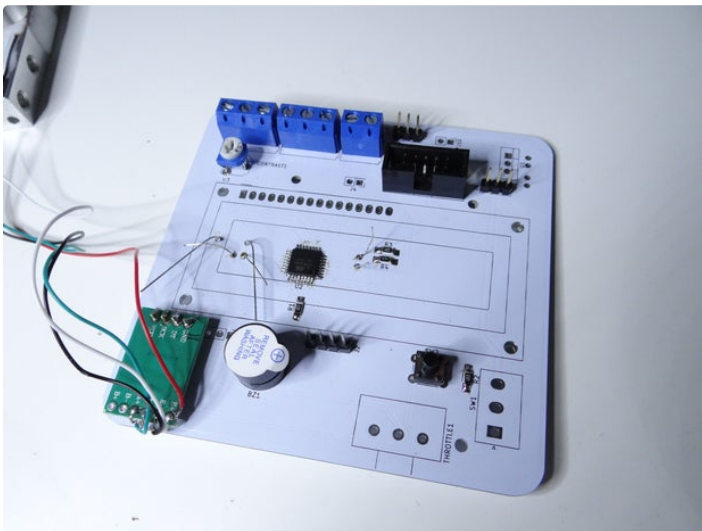
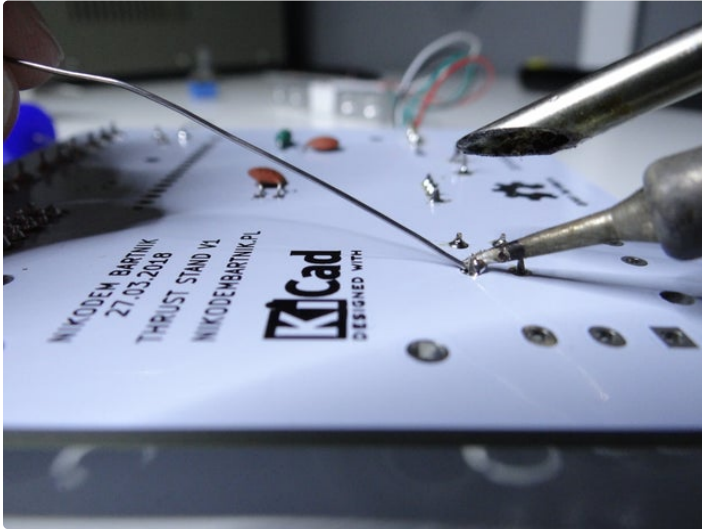
https://www.instructables.com/ORIG/FSC/8FY4/JPINX6TM/FSC8FY4JPINX6TM.kicad_pcb

Download

Step 3: Soldering

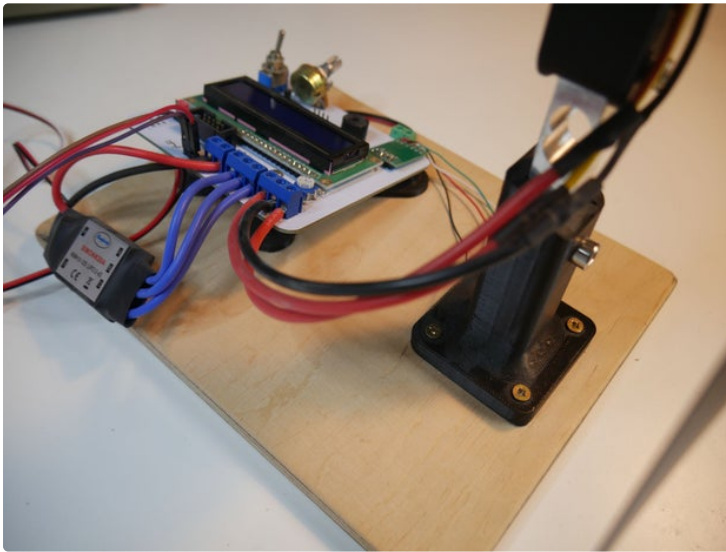
If you are building on a breadboard you can skip this step but for a PCB it's kind of essential :) As always while soldering start with the smallest SMD components. Atmega328 SMD is not easy to solder so if you have no experience maybe ask for help. Atmega is hidden below LCD display. Tensometric beam module should be also

soldered to the PCB as you can see above. Current sensor should be soldered on the bottom of PCB (I know that's not the best solution but works kind of fine for me).



Step 4: Base

We also have to build a base and 3D print some components. I used 8mm plywood as base and print out those STL files with black PLA. Then I fixed everything with screws.



	https://www.instructables.com/ORIG/FUX/I3JN/JPINX77O/FUXI3JNJPINX77O.stl	View in 3D	Download
	https://www.instructables.com/ORIG/FW9/FKEF/JPINX7F8/FW9FKEFJPINX7F8.stl	View in 3D	Download
	https://www.instructables.com/ORIG/FTE/LIUN/JPN3N3HO/FTELIUNJPN3N3HO.stl	View in 3D	Download

Step 5: Code

Here is code that you have to upload to the Arduino, it's really simple and short all it do is reading data from sensors and displaying it on LCD screen, no sophisticated math or any fancy programming things. I am not a fan of comments in the code so if you have any question just ask me :)

```
#include "HX711.h"
#include

#include
LiquidCrystal lcd(4, 3, 5, 6, 7, 8);
#define calibration_factor -400000.0
#define ESC_PIN 9
#define POT_PIN A0
#define BUZZER 2
#define CURRENT_SENSOR A2
#define VOLTAGE_PIN A1

HX711 scale(A4, A5);
Servo esc;
void setup() {
  pinMode(BUZZER, OUTPUT);
  lcd.begin(16, 2);
  lcd.print("Thrust Stand 1");
  delay(1000);
  scale.set_scale(calibration_factor);
  scale.tare();
  esc.attach(ESC_PIN);
  while(analogRead(POT_PIN) > 20){
    lcd.print("TO START SET");
    lcd.setCursor(0,1);
    lcd.print("THROTTLE TO 0");
    delay(200);
    lcd.clear();
  }
}
```

```

}

void loop() {

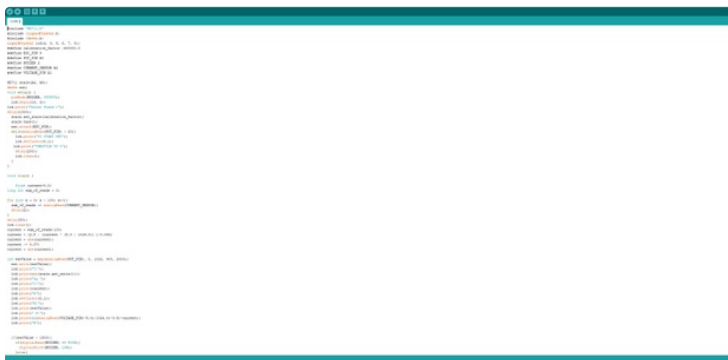
    float current=0.0;
    long int sum_of_reads = 0;

    for (int x = 0; x < 100; x++){
        sum_of_reads += analogRead(CURRENT_SENSOR);
        delay(2);
    }
    delay(50);
    lcd.clear();
    current = sum_of_reads/100;
    current = (2.5 - (current * (5.0 / 1024.0))) / 0.066;
    current = abs(current);
    current -= 0.07;
    current = abs(current);

    int escValue = map(analogRead(POT_PIN), 0, 1023, 900, 2000);
    esc.write(escValue);
    lcd.print("T:");
    lcd.print(abs(scale.get_units()));
    lcd.print("kg ");
    lcd.print("C:");
    lcd.print(current);
    lcd.print("A");
    lcd.setCursor(0,1);
    lcd.print("E:");
    lcd.print(escValue);
    lcd.print(" P:");
    lcd.print((((analogRead(VOLTAGE_PIN)*5.0)/1024.0)*3.5)*current);
    lcd.print("W");

    if(escValue > 1500){
        if(digitalRead(BUZZER) == HIGH){
            digitalWrite(BUZZER, LOW);
        }else{
            digitalWrite(BUZZER, HIGH);
        }
    }else{
        digitalWrite(BUZZER, LOW);
    }
}
}

```

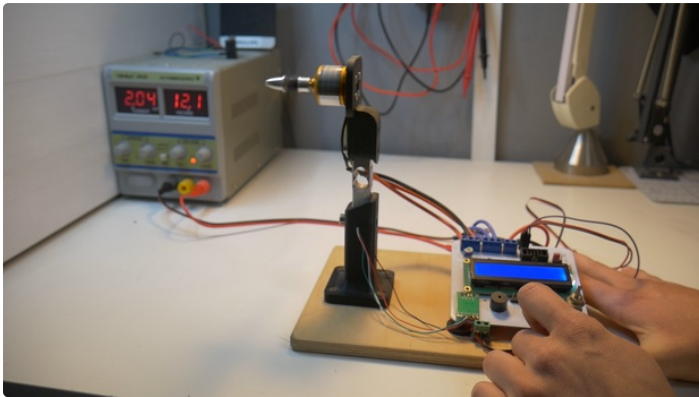


Download

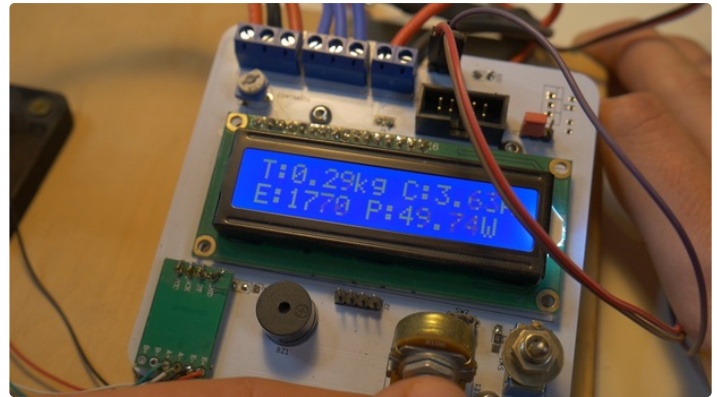
<https://www.instructables.com/ORIG/FGH/8PMW/JPINXEB/FGH8PMWJPINXEB.ino>

Step 6: Test

Once everything is ready we can test it! Be careful, brushless motor is really powerful and with that big propeller, it's really dangerous. To power it, you can use anything that works with your motor and ESC (if you use BEC power). I am using my lab bench power supply which is sometimes not powerful enough for this motor.



On the LCD screen, you can see thrust, current, throttle value and power consumption of the motor. That's essential data to design a good quadcopter and find a proper propeller for a motor



Step 7: Conclusion

I hope you enjoyed this instructable! Let me know if you have any questions/ideas in the comments!

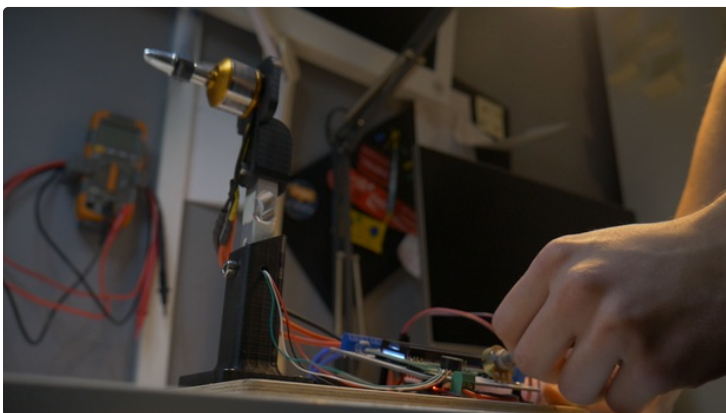
YouTube: <https://goo.gl/x6Y32E>

Facebook: <https://goo.gl/ZAQJXJ>

Instagram: <https://goo.gl/JLFLtf>

Twitter: <https://goo.gl/JLFLtf>

Happy making!



Hey, nice job.
Where did you get HX711.h library from?
Thanks,



<https://github.com/bogde/HX711>

I hope you've got it before but any other could need it too.

Best regards.

Videoenquirer



Hola Nikodem:

Ya he recibido los pcb de pcbway y veo que no pone los valores de los componentes. Siguiendo tus instrucciones he ido al esquema ya las fotos del instructable y veo que me faltan los valores siguientes:

L1: No se que componente es y su valor es ilegible en el esquema?

R3 y R4 cuales son sus valores?

Pot lcd contraste: No pone valor. Normalmente es de 10 K?

Microcontoller de maceta en el pin 23: Cual es su valor?

C3-C4: No estoy seguro de su valor. Es 100uf o 100nf?

Gracias anticipadas.



Okay, so I've looked everywhere (I even installed KiCAD) and I do not see the values for R3 and R4. can you list those please?

Also, your connection for the ESC is incorrect. It should be Signal, 5v, ground.
Should be an easy modification to the board's layout.



came over from Hackaday:

This is an absolutely great build given that it's all self-designed PCB and hand-soldered SMD – great work!

Having worked with load cells for a very long time, I'm curious how you calibrated the load cell/thrust output (maybe I missed something) – it looks like you're just trusting the data sheet for information (the code has a very simple calibration factor in it). If it's not calibrated, you'll just have a relative value for thrust.

The simplest “good enough” calibration for this rig would be to orient the beam horizontally with the motor mount facing upward and then hang a series of known weights on it from the center of the motor mount. Unless gravity's gone wonky you'll get pretty good calibration values.

Again, great work - hope to see many more great projects in future.



Thanks! Cool to know that my project is on Hackaday! Of course, I calibrated it before using it, there is a sketch in the examples of a library for this module that explain how to do the calibration. It's basically as simple as you said. The program calculates some kind of an offset that is a constant value that you have to add to your code. I checked if it can measure weight of few objects and it's really precise. Thank you!



Looks like fun, but nicely done. Beats starting a big old diesel engine in a bench vice. Fingers out of the way before the engine fires. The brushless motors have transformed all aspects of aero-modelling. I love to see these drones operating - huge future potential



Thanks!



Hi!

Very nice job.

I was not able to find the top of the beam, the motor mount.

Is that available?

Thanks!



Thanks, looks like I uploaded old PCB case design instead of motor mount, thanks for pointing out! You can find it in step 4



That's awesome!!!
My vote goes for you...



Thank you very much!



Nice work, well done!!!
Hope to see more from you in the future.



Thanks, subscribe to my channel to don't miss it :)