Differential Dynamometer for Stroke Rehabilitation
Build instruction

Bill of Materials

We use in the project the components

1	Controller	Arduino nano R3	1
2	24 bit ADC shield	HX-711 shild	4
3	8 digits LED shield	max7219 0,36"LED shield	2
4	Tenso brigde	Kitchen Scale Sensor 5 kG	4
5	Push button	Any push button	2
6	Box for device	G1168G Gainta	1
7	Sensor mounting base	Plastic cutting board	1
8	Sensor cable connector	DB25f	1
9	Screws M5x25 mm		8
10	Nuts M5		8
11	Washer 5x10x4 mm		8

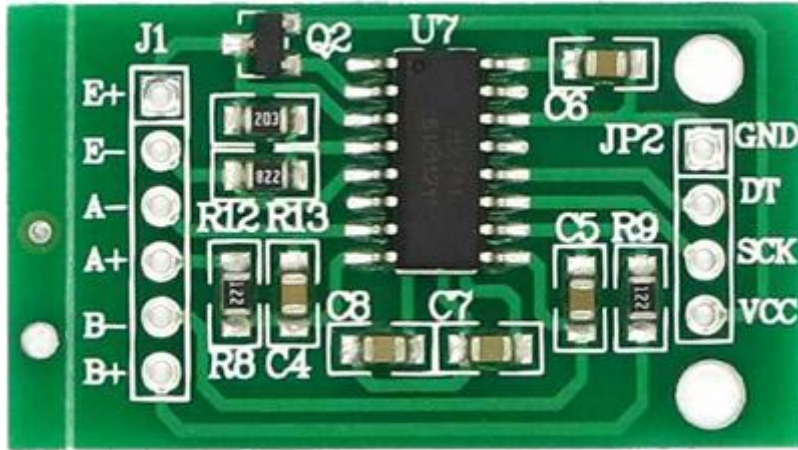We make some introduction about it.

1. Controller Arduino Nano R3.x (992-ARD-NANO30NP) or any Arduino Nano R3.x compatible.

The Arduino IDE code works with any native or compatible PCB.

2. 24 bit ADC shield

We use Arduino compatible kitchen scale shild (PCB) with HX-711 chip. The signal from tensobridge is very small, so we need at least 24 bit sigma / delta ADC.

It is possible to use 2 or 4 shields, we use 4 because the chip has a long enough (>80 milliseconds) conversion time.
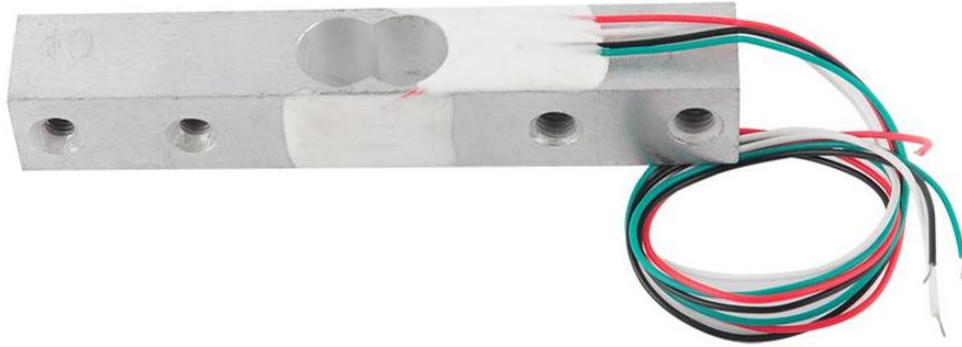
3. Max7219 0,36"LED shield

The Shield made using max7219 chips. The shields (two) show the force of fingers press in digital (4 signs in Gramms) or bar views.

4. Strain Gauges 5 kG

We recommend to use 5 kG Kitchen Scale Sensor sensors, but You can use any kind of sensors in the range 1 kGramms- 10 kGramms.
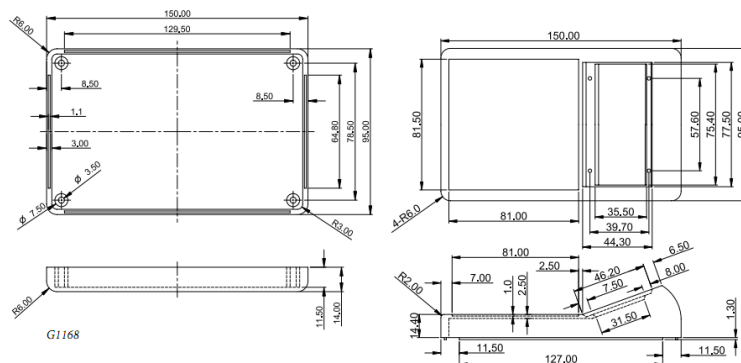
5. Push button
    You can use one any momentaty normal open push button, and one toggle
    push button.

6. Box for device

We use G1168G Gainta box. It is very convenienf for display installation.

7. Sensor mounting base

We used plastic cutting board, but any flat surface can be used.

8. Sensor cable connector   DB25f and DB25m Cable

You can make the device without connectors, with direct cable connections. We suppose that the device with connectors can be used with other sensor board- for foots etc…You can use Mouser 649-DB25P064TXLF. Cable is shown on the figure too.
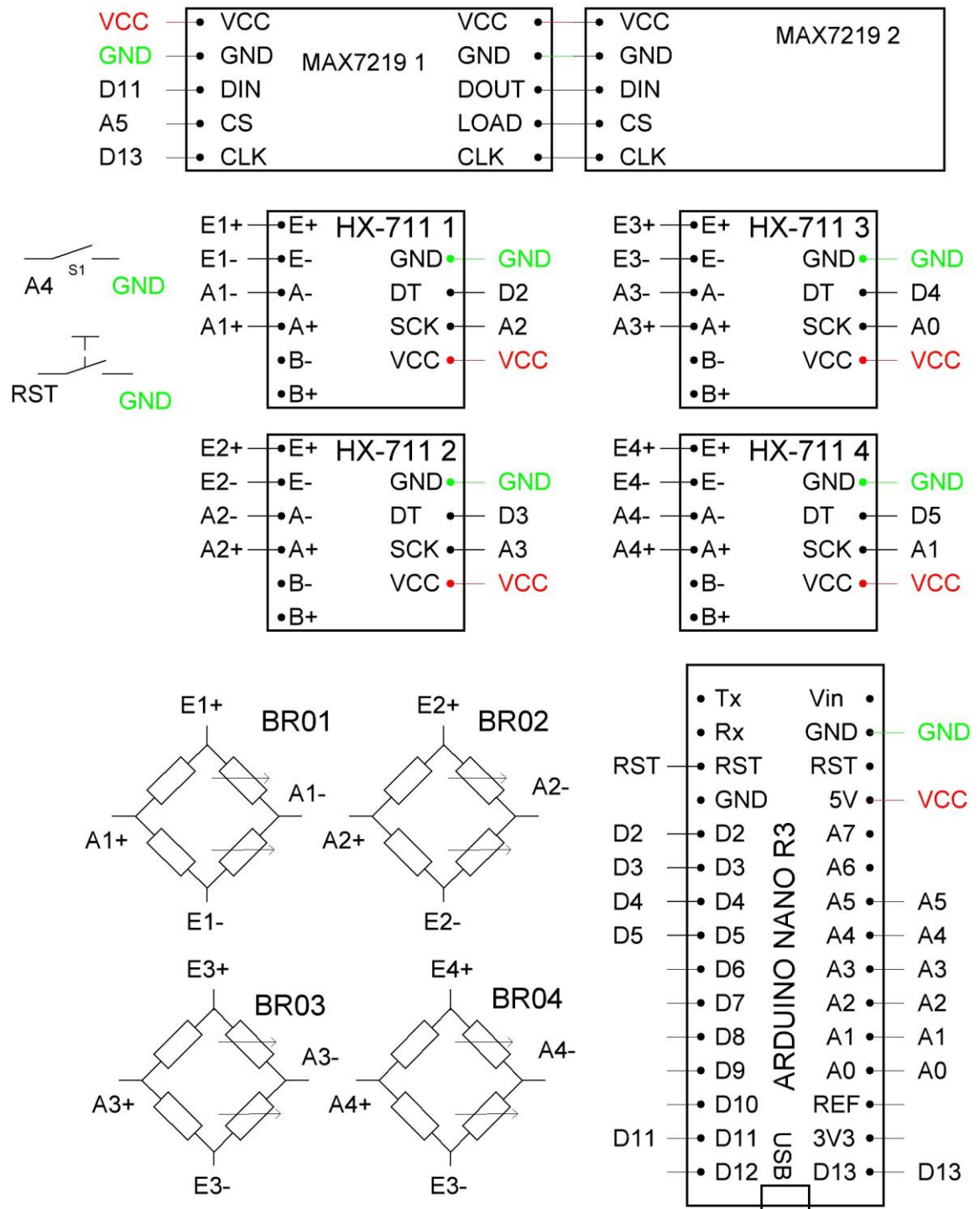
9-11. Nuts, screws and washers

The size of screw-thread depends on screw-thread of strain gauges. 5 and 10 kGramms sensors has M5 (metric 5 mm) screw-thread, 1-2 kGramms sensors have M4 screw-thread.

Schematics

4 CHANNEL DIFFERENTIAL DYNAMOMETR LED 8X2

MAX7219 1

VCC	VCC	VCC	VCC
GND	GND	GND	GND
D11	DIN	DOUT	DIN
A5	CS	LOAD	CS
D13	CLK	CLK	CLK

MAX7219 2

HX-711 1

E1+	E+		
E1-	E-	GND	GND
A1-	A-	DT	D2
A1+	A+	SCK	A2
	B-	VCC	VCC
	B+		

A4 S1 GND

RST GND

HX-711 3

E3+	E+		
E3-	E-	GND	GND
A3-	A-	DT	D4
A3+	A+	SCK	A0
	B-	VCC	VCC
	B+		

HX-711 2

E2+	E+		
E2-	E-	GND	GND
A2-	A-	DT	D3
A2+	A+	SCK	A3
	B-	VCC	VCC
	B+		

HX-711 4

E4+	E+		
E4-	E-	GND	GND
A4-	A-	DT	D5
A4+	A+	SCK	A1
	B-	VCC	VCC
	B+		

BR01 — E1+, A1-, A1+, E1-

BR02 — E2+, A2-, A2+, E2-

BR03 — E3+, A3-, A3+, E3-

BR04 — E4+, A4-, A4+, E3-

ARDUINO NANO R3

	Tx	Vin	
	Rx	GND	GND
RST	RST	RST	
	GND	5V	VCC
D2	D2	A7	
D3	D3	A6	
D4	D4	A5	A5
D5	D5	A4	A4
	D6	A3	A3
	D7	A2	A2
	D8	A1	A1
	D9	A0	A0
	D10	REF	
D11	D11	3V3	
	D12	D13	D13

USB

Power supply is over miniUSB connector of Arduino Nano. It is usefull to solder some 0.1 uF 16 V capacitors on GND and VCC junctions of HX-711 shields, and 3300 uF 16 V low ESR capacitor parallel to VCC and GND pins.

Mechanical

You have to make holes for push button in any convenient place. We placed it on the right side of box, the DB25F connector- on the left side. You can do the device without connector, with wires soldered direct to HX-711 pins.
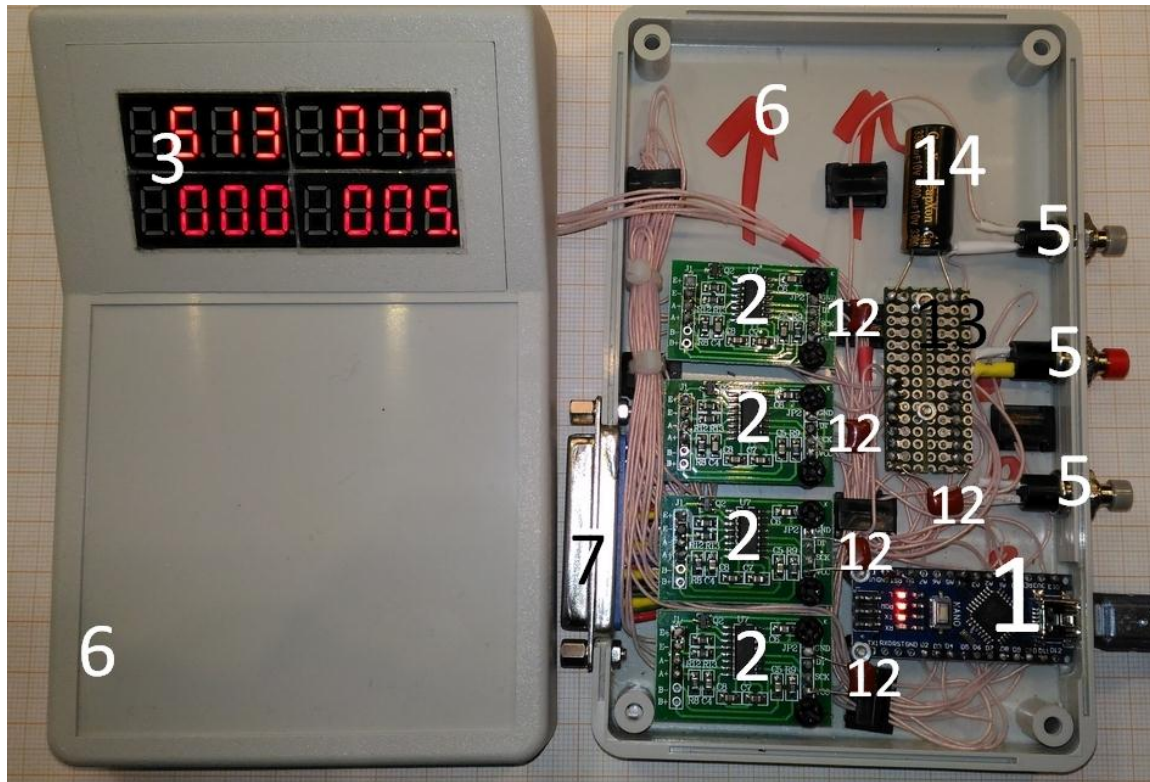

1   Controller

2   24 bit ADC shields

3   8 digits LED shields

5   Push button

6   Box for device

7   DB25F connector

8   Sensor cable connector

12   0.1 uF 16 V capacitors

13   PCB for GND and VCC connections

14   3300 uF 16 V low ESR capacitor

It is only one hole in upper box part- rectangular hole for two LED shields. It is good to make a hole with small mill cutter, but it can be done with knife and saw.
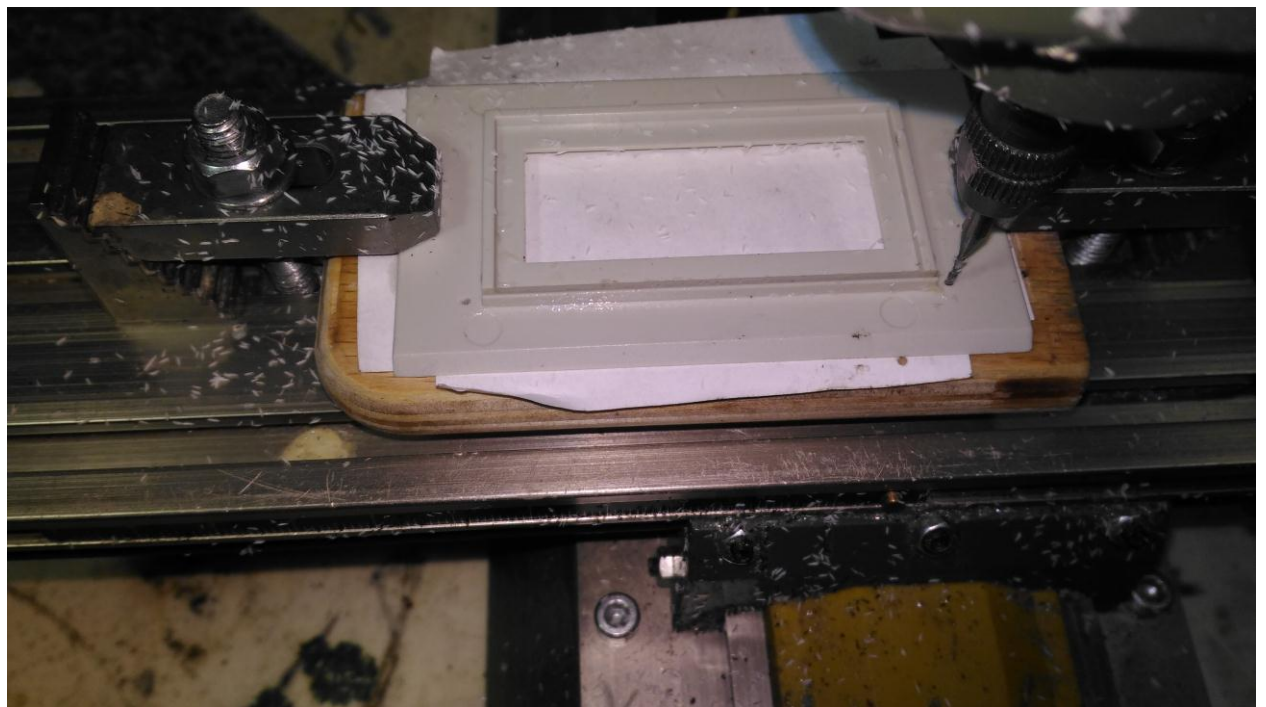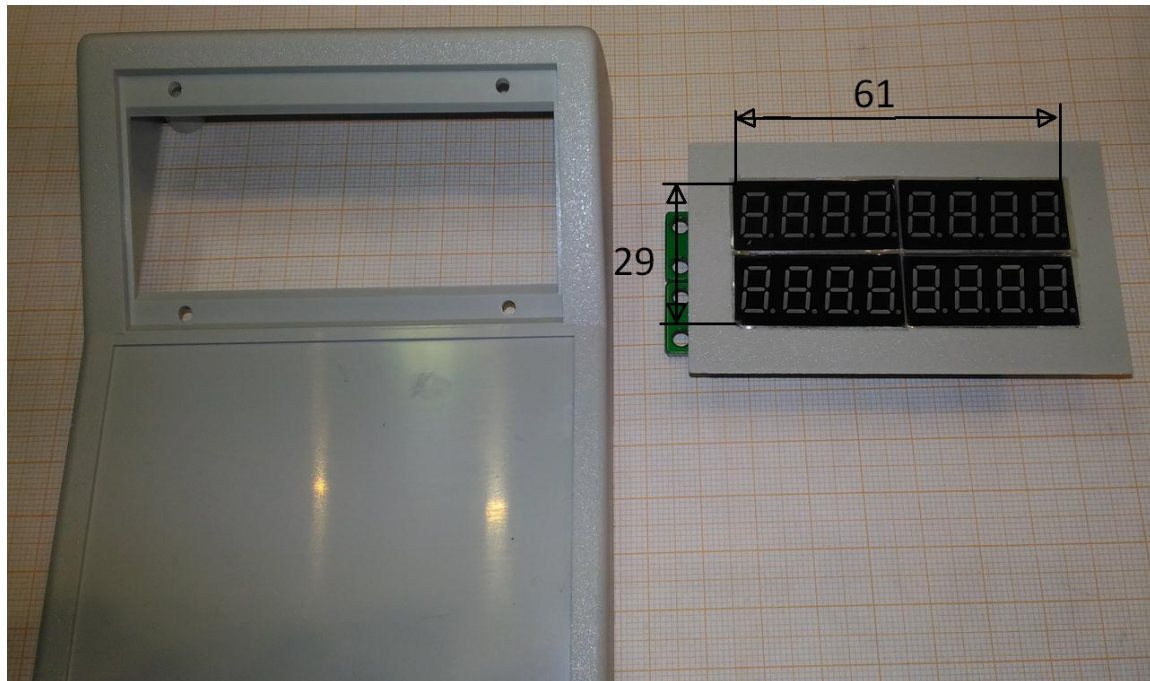
Miller cut the window in box top panel.
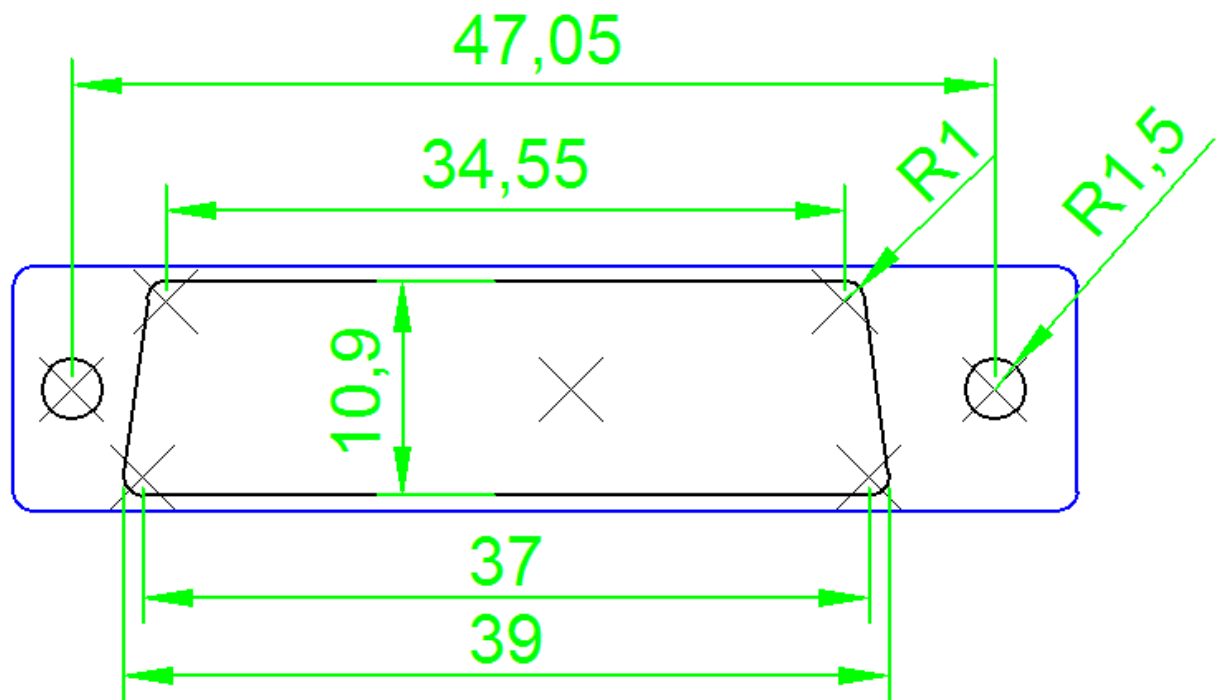
Hole for DB25F connector. Blue- external shield, black- hole , two round holes for screws.

Hole for Arduino USB mini is situated on the right side and has 8x4 mm size.

For installation of HX711, power and Arduino PCBs we use nylon PCB standoff (534-1903C) and nylon screws M3 and two M2 (for Arduino).

Electronics

If You are not experienced in electronics, You can test the device withot mount all the PCB and connectors. Here is example of device without box. All the PCBs and sensors are soldered by wires.
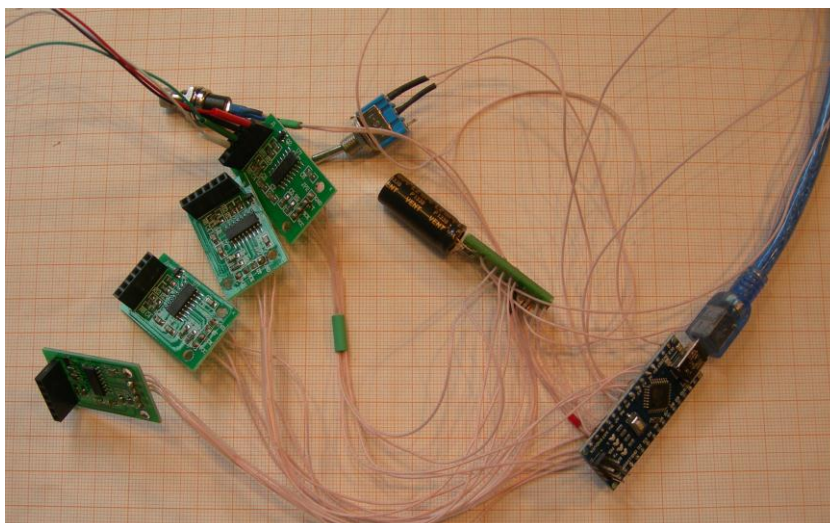
The example of such installation on a tray is shown here, and the sensors on the plywood board for cutting:
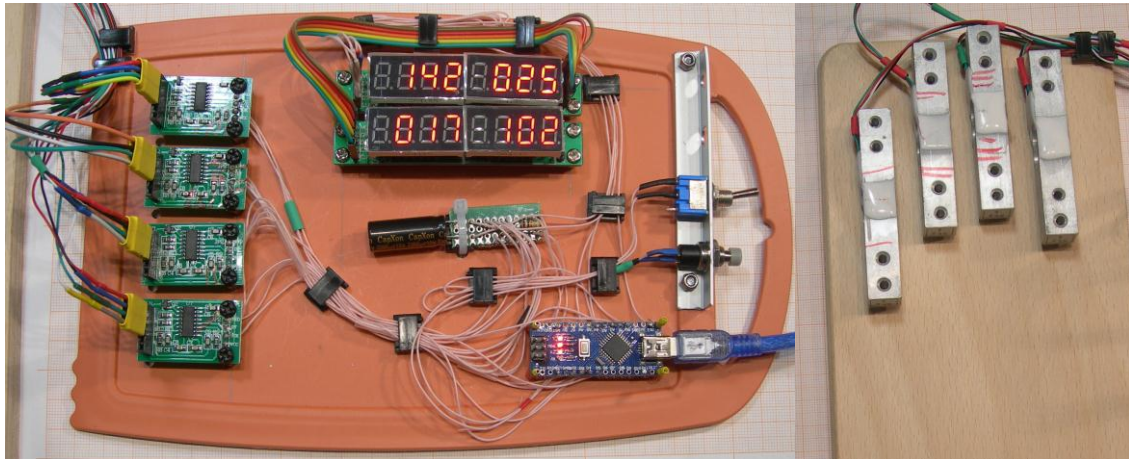
After adjustment and verification You can assemble all in box.

Programming

Install (if You have no) Arduino IDE, download *.ino file from depository https://github.com/DrOnkel/DifDin.git   and load it to Your Arduino Nano. If You use another sensors, You have to ajust parameters in lines :

146 CountW[0] /= 4280L;   // Calibrate 0

238 CountW[1] /= 4283L; //Calibrate sensor 1

338 CountW[2] /= 4280L; // Calibrate sensor 2

424 CountW[3] /= 4283L; // Calibrate sensor 3

You can place all the electronics in a box when You check all the connecrions.

Take an interesting experience. Electronics is usefull and interesting.