POST STROKE SPASTICITY REHAB HELPER
Build instruction V. 01

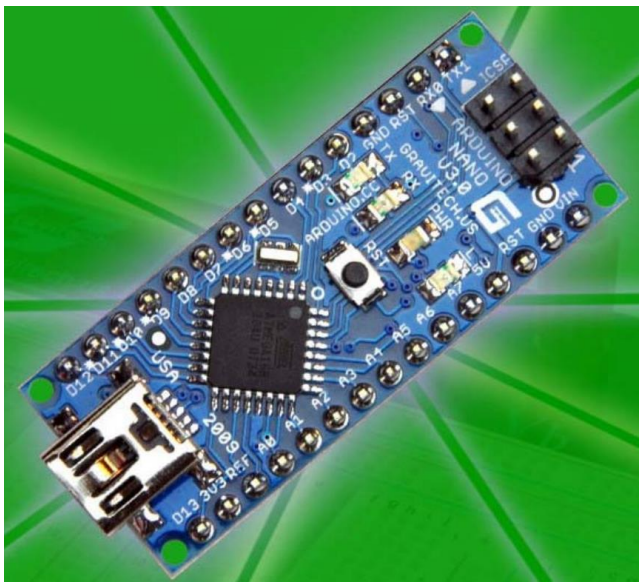
Bill of Materials

We use in the project the components

No	Q	Name	Description
1	2	Controller	Arduino nano R3
2	6	Tenzo Bridge	Pressure Sensor Scale Module
3	6	ADC fo Tenzo Bridge	HX-711
4	12	Servo mini SG90	Servo mini SG90 9g Tower Pro
5	0	Blue Tooth module	HC-05
6	6	Magnetic Snaps	3/4-inch size Magnetic Button Clasp Snaps
7	2	Shottky Diodes	Shottky Diodes 1N5817
8	2	3300 uF 16 V capacitor	Low ESR capacitor.
9	2	0.1 uF 16 V capacitor	Capacitor for high friequency noise damp.
10	3	Low base for servo	3D printed or milled plastic components
11	2	High base for servo	3D printed or milled plastic components
12	10	Servo mounted lever arm	3D printed or milled plastic components
13	6	Short node lever	3D printed or milled plastic components
14	4	Long node lever	3D printed or milled plastic components
15	2	Breadboard	Plastic Breadboard or other flat plastic

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. Servo SG90 9g Tower Pro

   You can use any type of Servo. Please pay attention that some servos can have other control pulse parameters.
3. 5 kOhms potentiometer

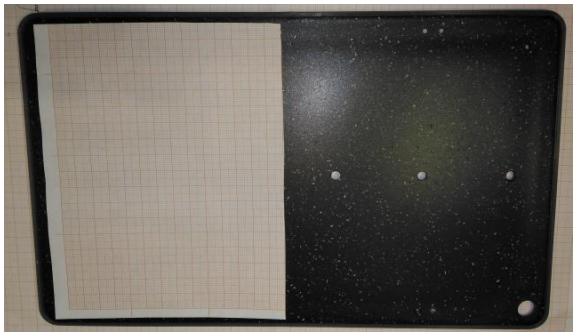
   Any type of linear potentiometer can be used, 1-10 kOhms.

4. Magnetic Button Clasp Snaps
   18mm (3/4-inch) size Magnetic Button Clasp Snaps

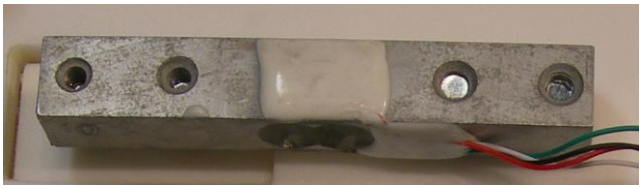
5. Shottky Diodes
   1N5817 Diodes.
6. 3300 uF 16 V capacitor Low ESR capacitor.

7. 0.1 uF 16 V capacitor
8. Low base for servo. All holders and lever arms for servos (components 10 – 14) are described in “Mechanics”.

9. High base for servo
10. Servo mounted lever arm. Big hole must fit servo shaft.
11. Short node lever
12. Long node lever
13. Breadboard.We used plastic cutting board, but any flat surface can be used.

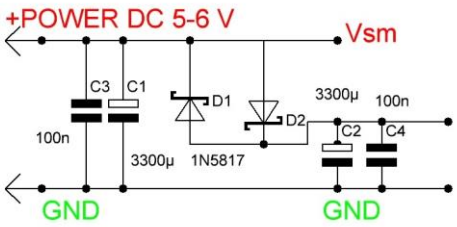


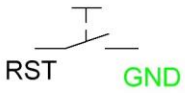
14. Scale weight sensors 10 kG (or other)

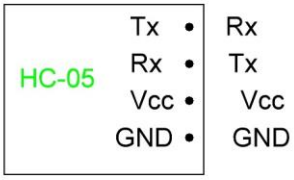


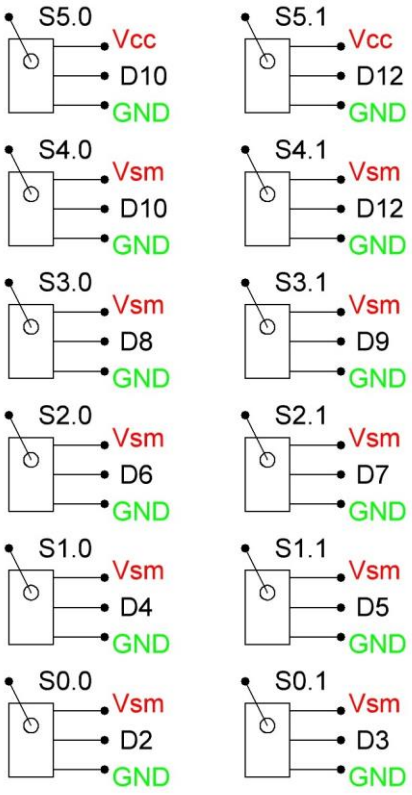
15. Nuts, screws and washers

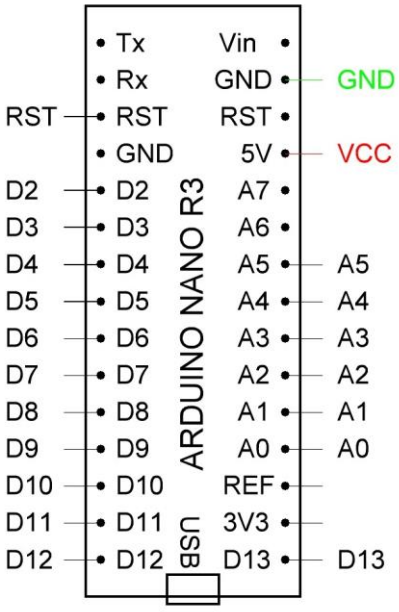
Schematics

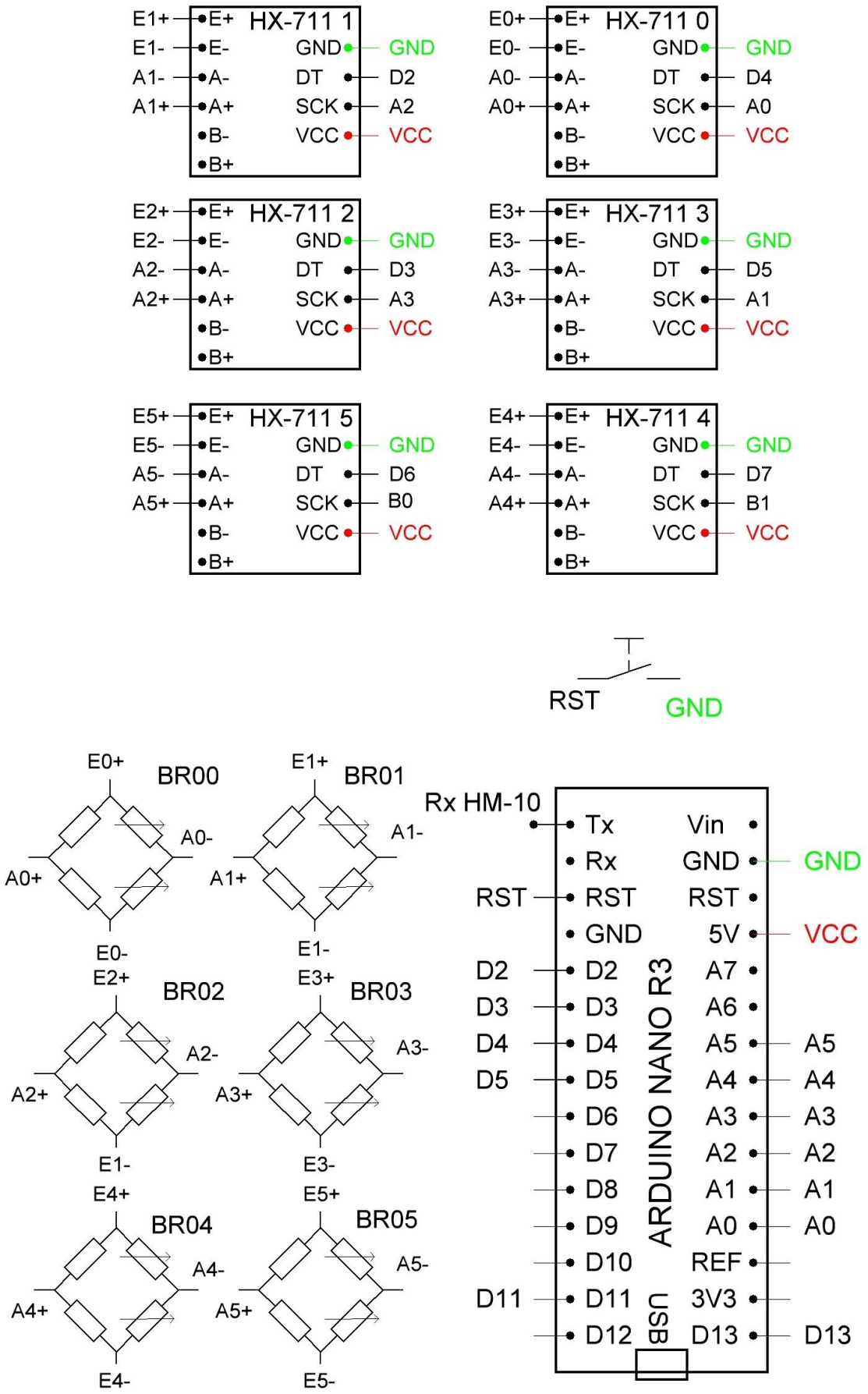

+POWER DC 5-6 V
Vsm
C3
C1
D1
3300µ
100n
D2
C2
C4
100n
3300µ
1N5817
GND
GND


RST
GND


HC-05
Tx
Rx
Vcc
GND
Rx
Tx
Vcc
GND


S5.0
Vcc
D10
GND
S5.1
Vcc
D12
GND
S4.0
Vsm
D10
GND
S4.1
Vsm
D12
GND
S3.0
Vsm
D8
GND
S3.1
Vsm
D9
GND
S2.0
Vsm
D6
GND
S2.1
Vsm
D7
GND
S1.0
Vsm
D4
GND
S1.1
Vsm
D5
GND
S0.0
Vsm
D2
GND
S0.1
Vsm
D3
GND

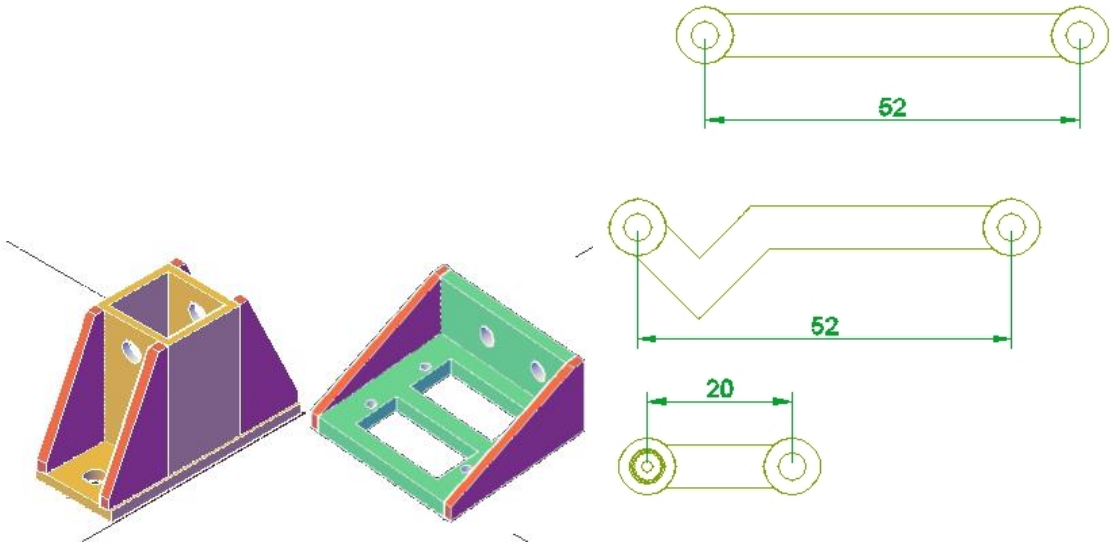

Tx
Rx
RST
GND
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
ARDUINO NANO R3
USB
Vin
GND
RST
5V
A7
A6
A5
A4
A3
A2
A1
A0
REF
3V3
D13
GND
VCC
A5
A4
A3
A2
A1
A0
D13



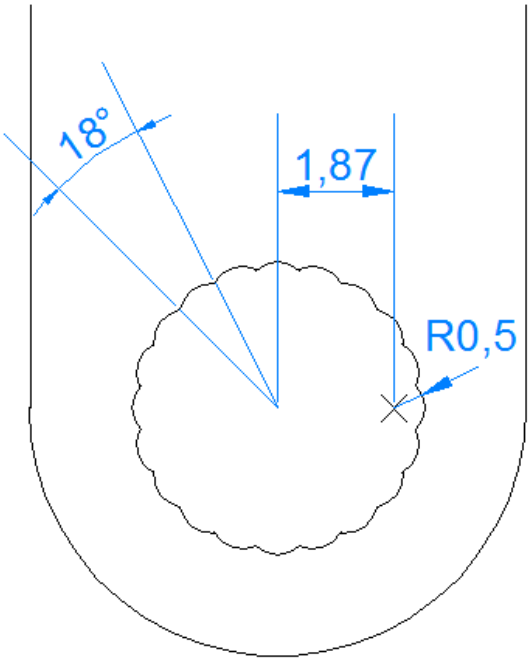
Peak power current can reach 2 A, so You have to use appropriate power supply. Not all computer USB connectors can give 2 A, so please be careful.

Mechanics

We use the simplest analogue servo. You can use any kind of servos. The bases, lever arms are shown in a figure:

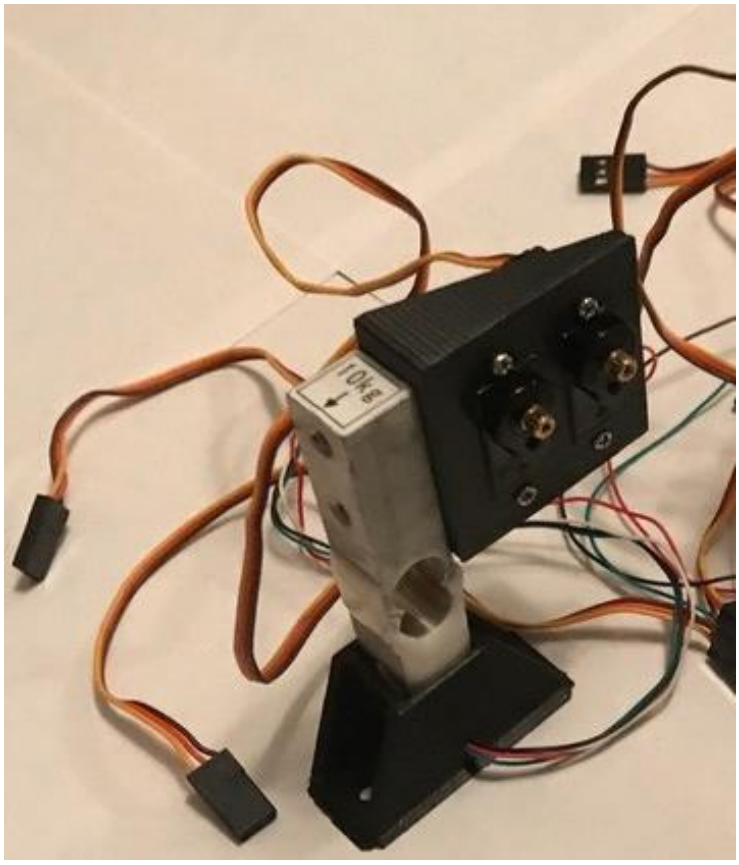


The only difficult part of mechanics component fabrication is lever arm 12. The perforation on arm must fit servo shaft perforation. We make perforation by drilling 20 holes via 18° (our servo shaft has 20 teeth) with 1mm radius drill with centers on the R=1.87 mm circle.

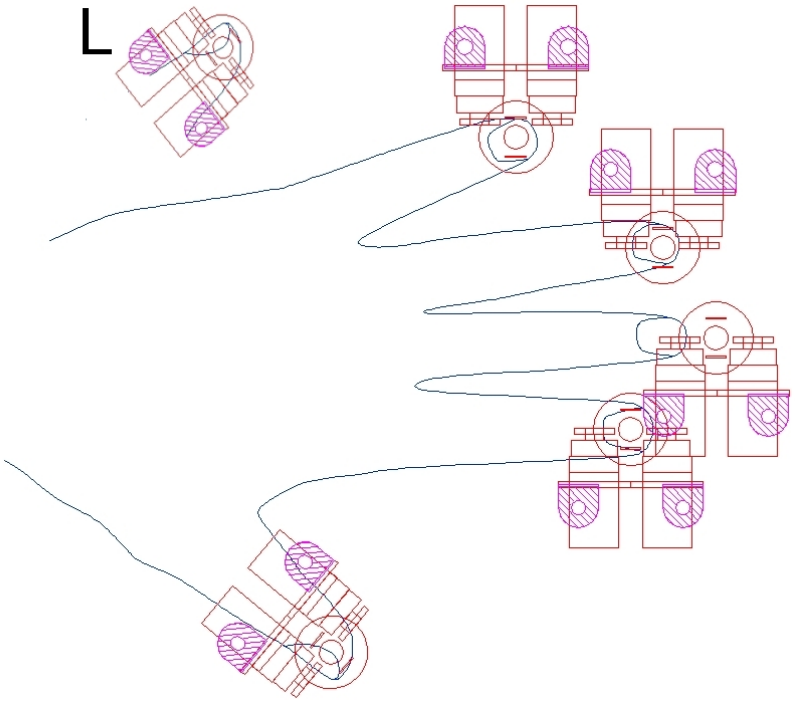


The drawings of lever arms and bases are here

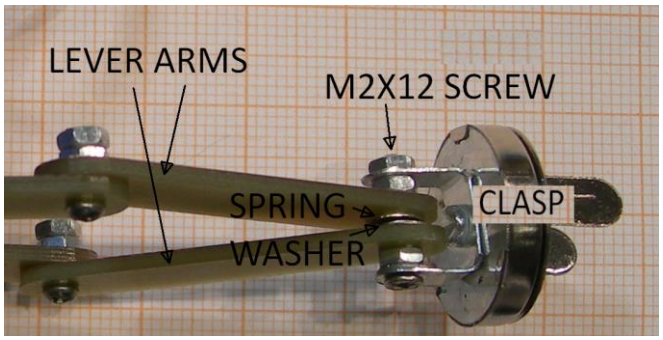
The size of components are defined by the servo in use. We made all drawings for Servo mini SG90 9g Tower Pro. Here is one block



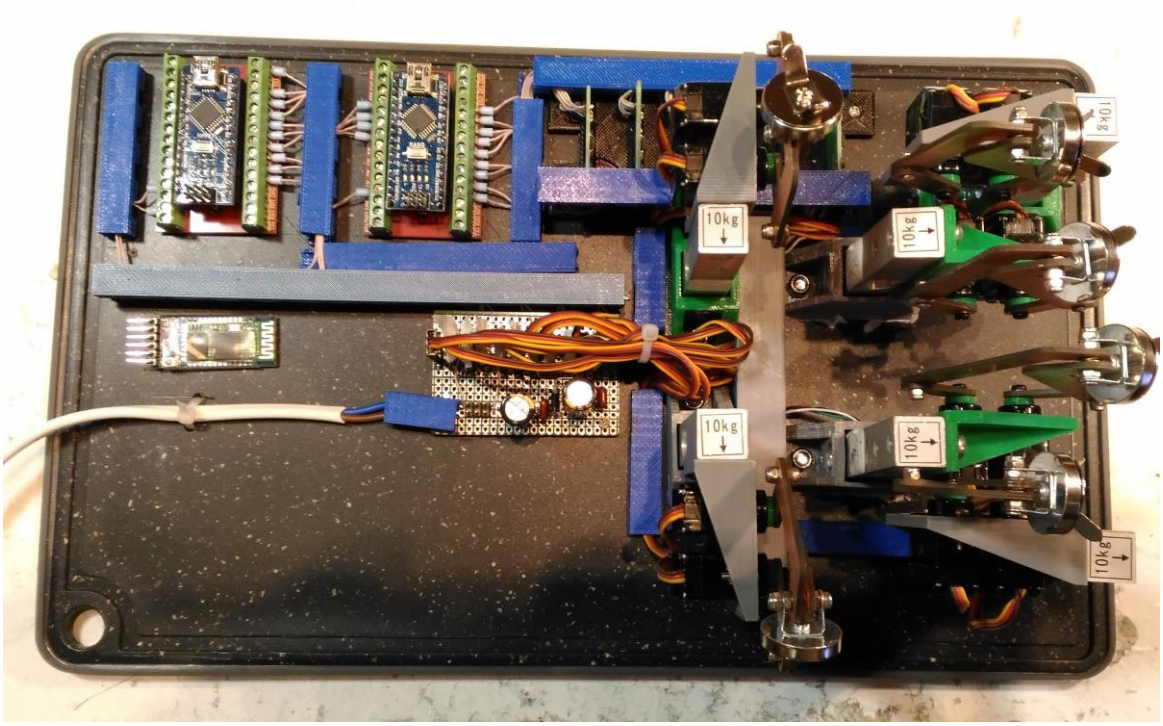
We took plastic breadboard and install 6 blocks on it, for example it is left hand drawing, L – for the right hand.



We use 3/4-inch size Magnetic Button Clasp Snaps. It is screwed with two node lever arms so it can be rotated.

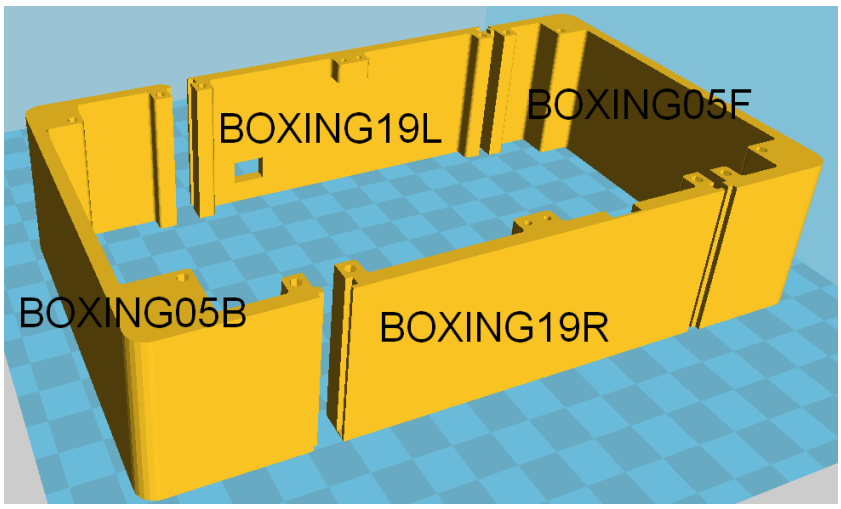


Here You can see the breadboard with installed blocks and fully assembled

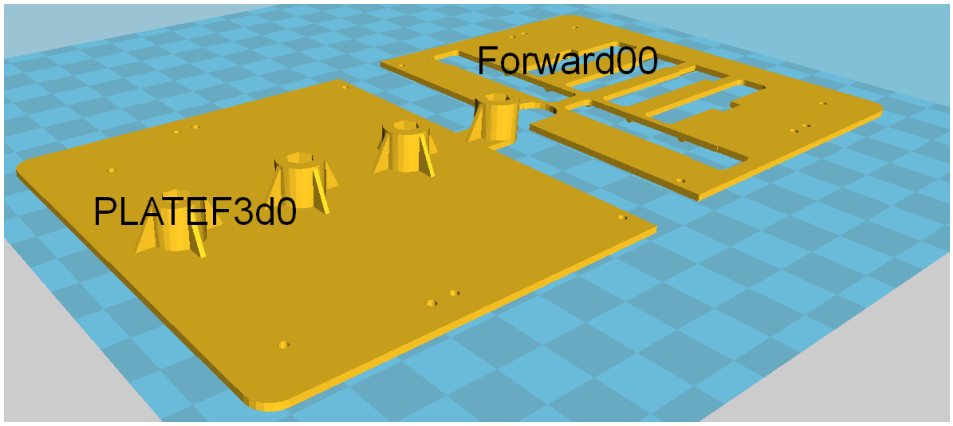


External Box and Hand Holder

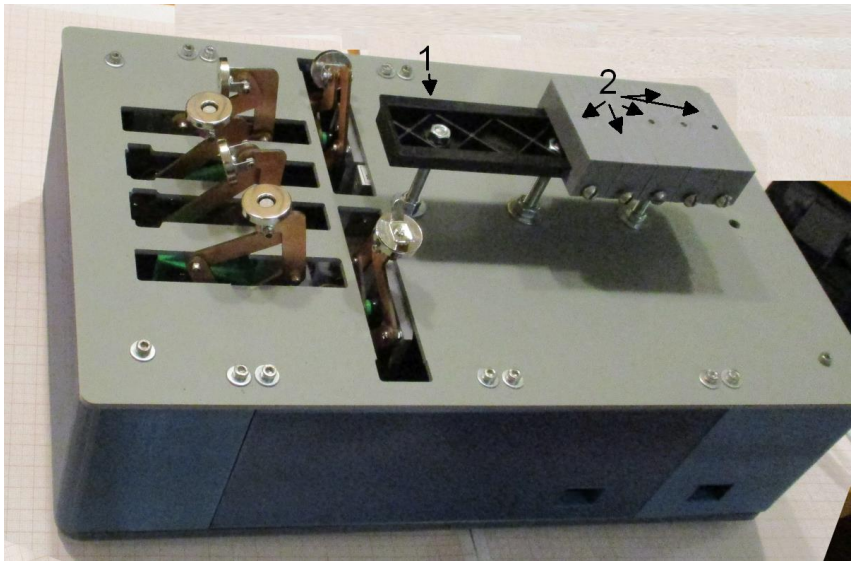
We construct 3d box for 3d printer. The box is bigger than 3d printer base and we devide the component by 2 or 3 parts. Here is 4 side parts of box



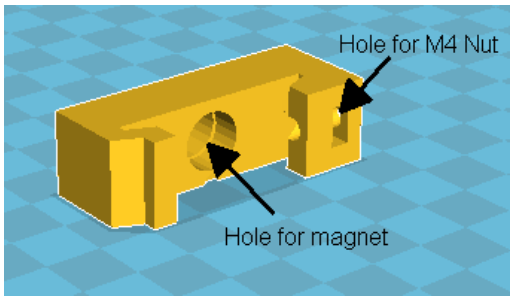
Here is top deck, we connect it to the sides of the box

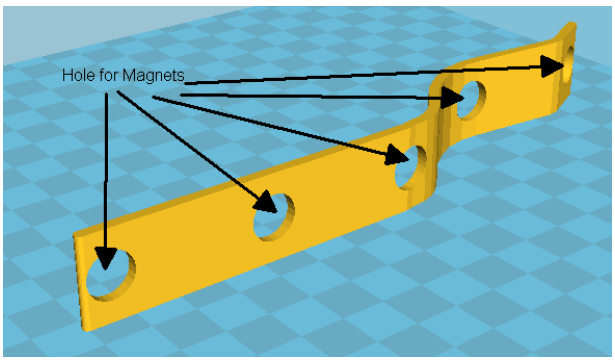


We hold the parts together. We use plastic DIN- rail (1) and magne holders (2)



Part 2 contains magnet for attaching hand holder with magnets too.

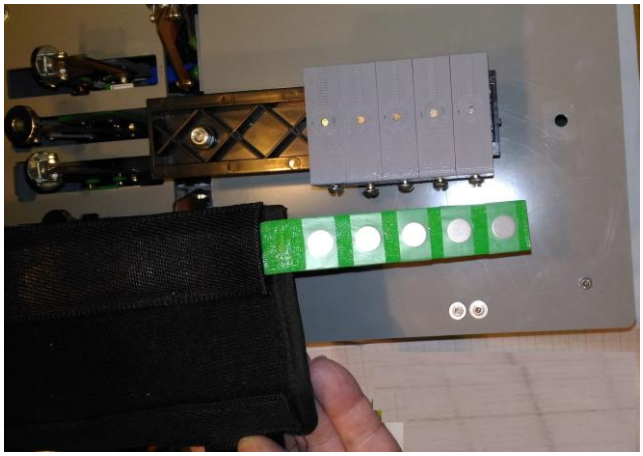




3d stl files on https://github.com/DrOnkel/ReHabJr :

Boxing05B.stl	Down side of box
Boxing05F.stl	Forward side of box
Boxing19L.stl	Left side of box
Boxing19R.stl	Right side of box
DinHolder10.stl	Magnet holder for DIN
FlateF3d0.stl	Box top 1
Forward00.stl	Box top 2

We use hand holder



Programming

Program code is Arduino IDE compatible. You can download code from git hab https://github.com/DrOnkel/ReHabJr or Hackaday project file section.

BuildInstruction2.pdf This instruction

DifDinLCD.ino Arduino code for Diffirential Dynamometer controller

Dinamometr_Schematics.jpg Add files via upload 6 days ago

ServoMotorsSchematics.jpg Add files via upload 6 days ago

ServoRehab01.ino Arduino code for servo controller, USB control version

ServoRehab_i_06.ino Arduino code for servo controller, BT control version

Download the program to Your Arduino Nano using Arduino IDE. You can download it from arduino.cc .

The movement is defined by arrays MassX[8][2]. It contains 8 main points of finger base path. The movement between main points is calculated using linear interpolation. The full review of program code is in Program instruction.

Math and Calculation.

We calculate the angles of servo using simple model. Doctor give as some function X=X(t), Y=Y(t). We simulate the movement using model and test program ServoPot2Tester.ino (download from git hab https://github.com/DrOnkel/Rehab/tree/ReHab0 or from file section of our Hackaday project), two potentiometers (A0, A1) and two servo (pins 2,3).

Conclusion.

Take an interesting experience. Electronics is usefull and interesting.