# POST STROKE SPASTICITY REHAB HELPER
# Build instruction V. 01

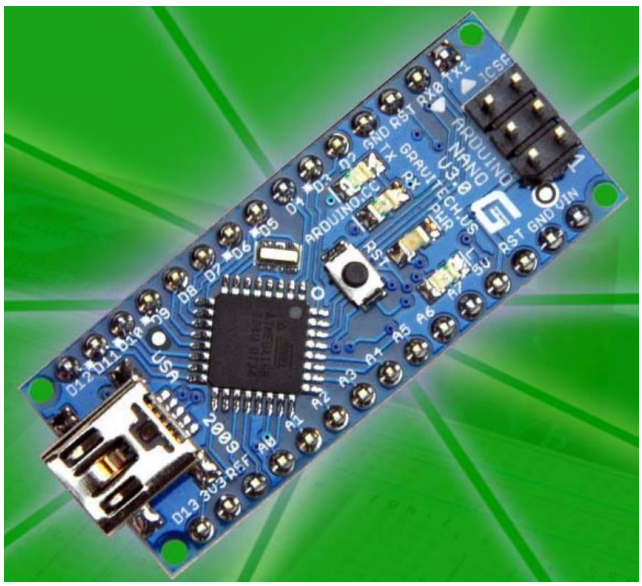
## Bill of Materials

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

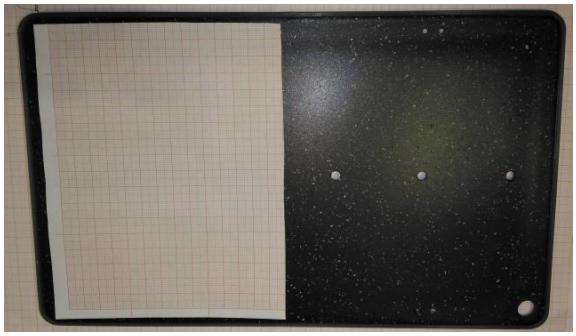
   Any type of linear potentiometer can be used, 1-10 kOhms.

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.

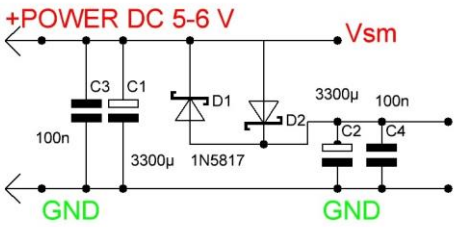
7. 0.1 uF 16 V capacitor
8. Low base for servo. All holders and lever arms for servos (components 10 – 14) are described in “Mechanics”.

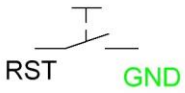
9. High base for servo
10. Servo mounted lever arm. Big hole must fit servo shaft.
11. Short node lever
12. Long node lever
13. Breadboard.We used plastic cutting board, but any flat surface can be used.

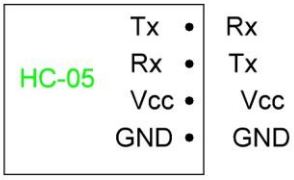


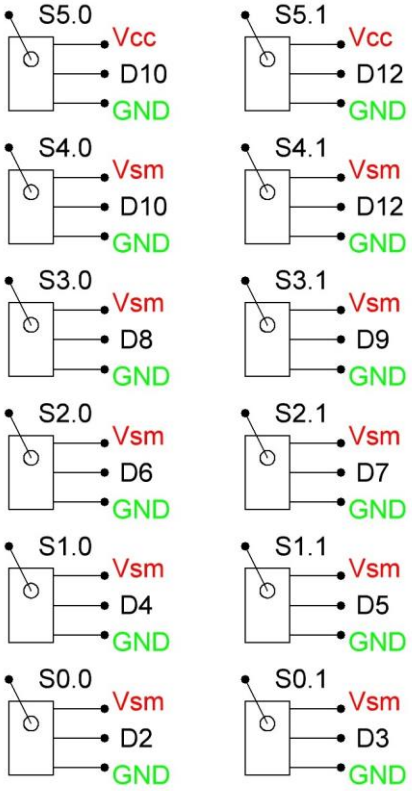
14. Nuts, screws and washers

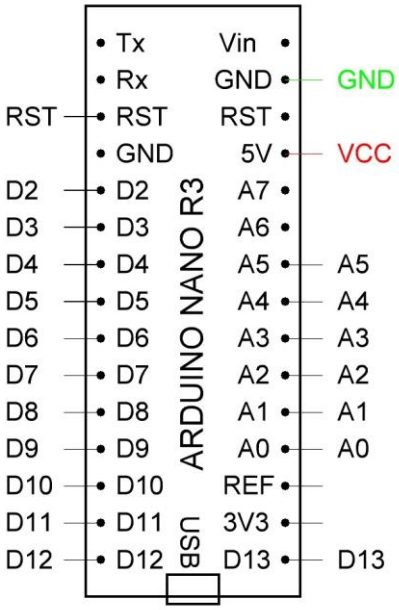
# Schematics

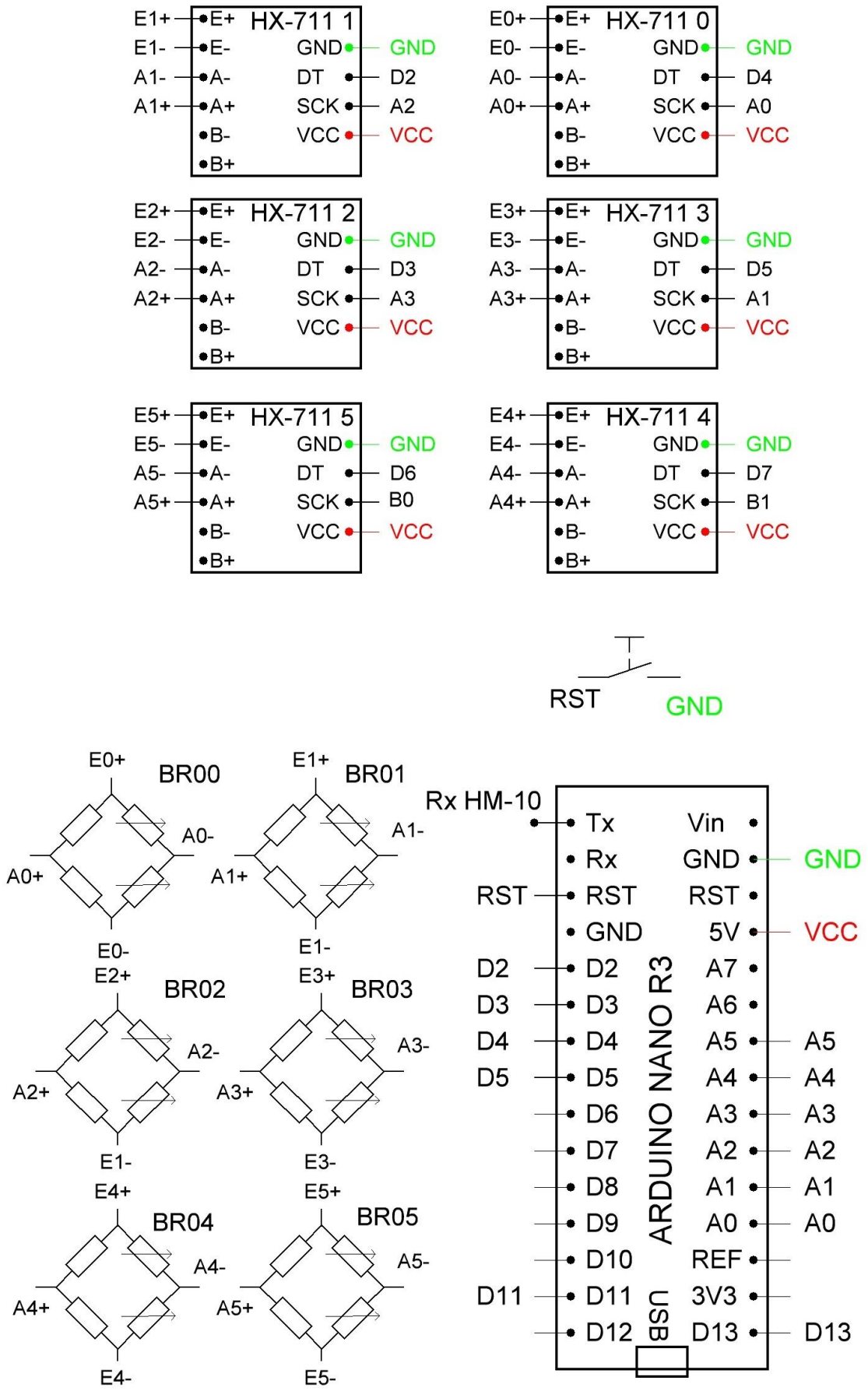

+POWER DC 5-6 V
Vsm
C3
C1
D1
3300µ
100n
D2
C2
C4
100n
3300µ
1N5817
GND
GND


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

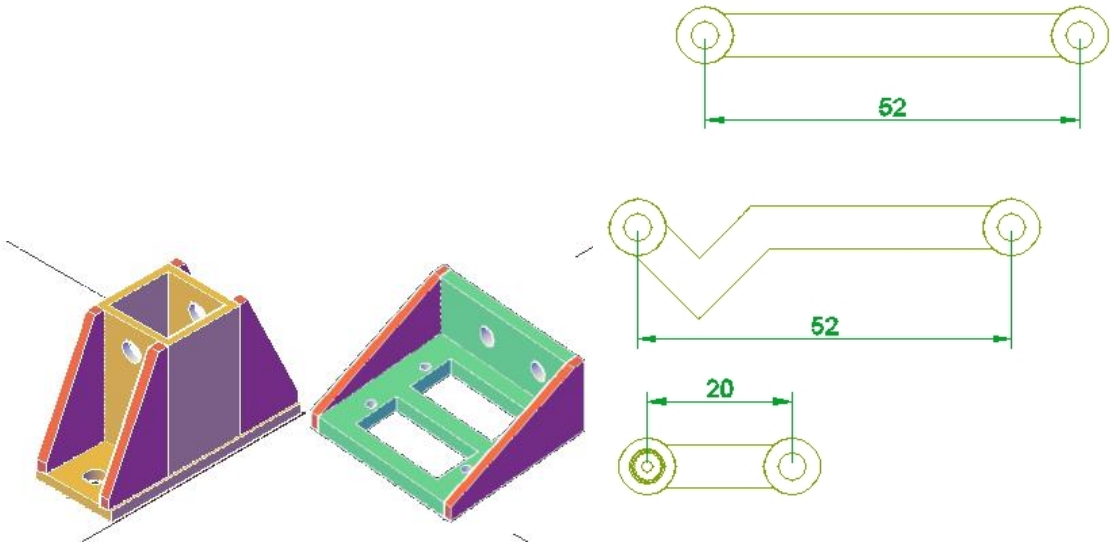

Tx
Rx
RST
GND
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
ARDUINO NANO R3
USB
Vin
GND
RST
5V
A7
A6
A5
A4
A3
A2
A1
A0
REF
3V3
D13
GND
VCC
A5
A4
A3
A2
A1
A0
D13



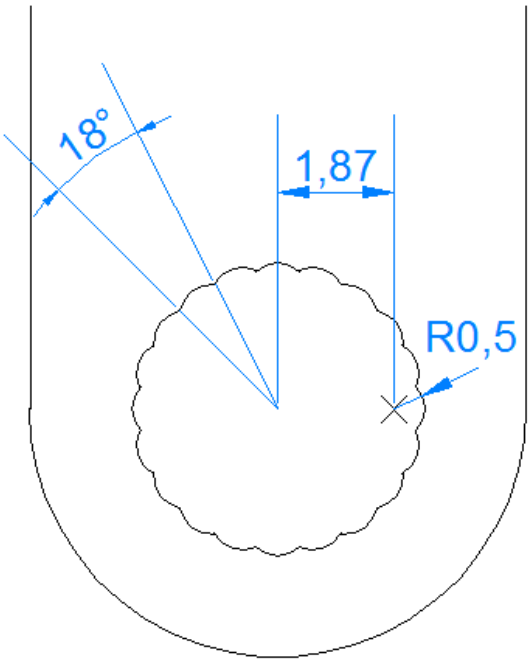

Peak power current can reach 2 A, so You have to use appropriate power supply. Not all computer USB connectors can give 2 A, so please be careful.

## Mechanics

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

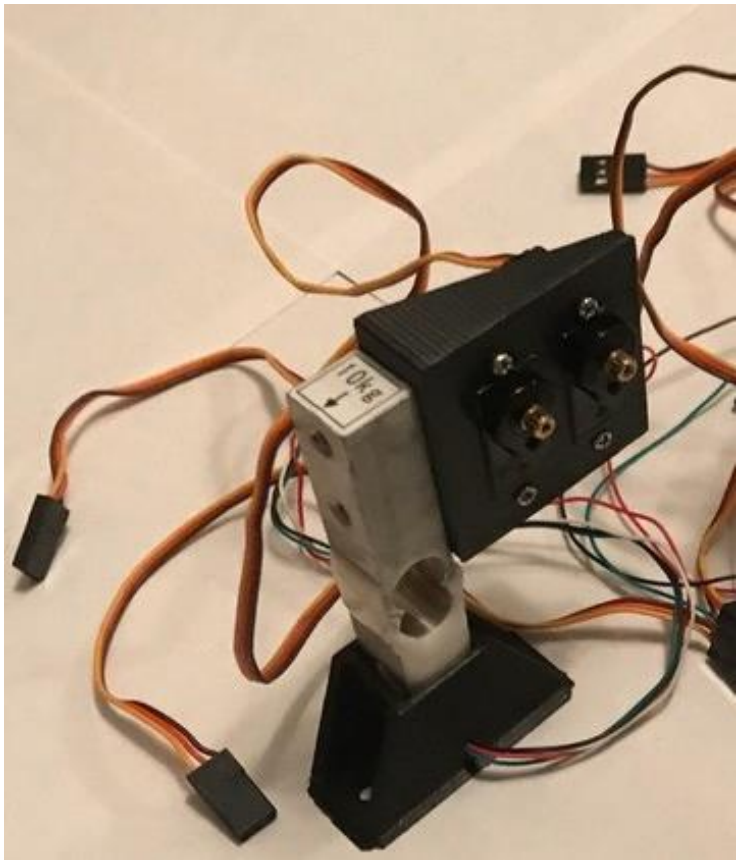



The only difficult part of mechanics component fabrication is lever arm 12. The perforation on arm must fit servo shaft perforation. We make perforation by drilling 20 holes via 18° (our servo shaft has 20 teeth) with 1mm radius drill with centers on the R=1.87 mm circle.

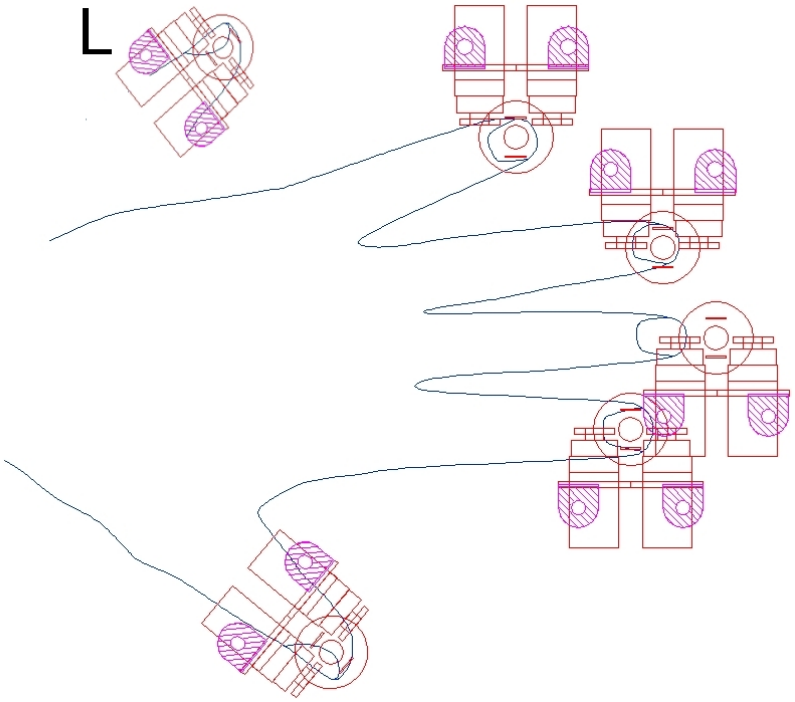



The drawings of lever arms and bases are here

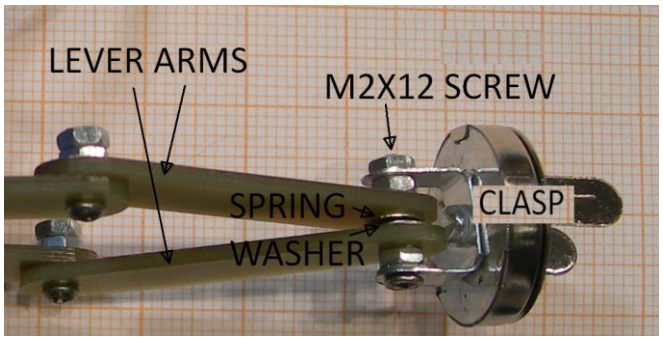
The size of components are defined by the servo in use. We made all drawings for Servo mini SG90 9g Tower Pro. Here is one block



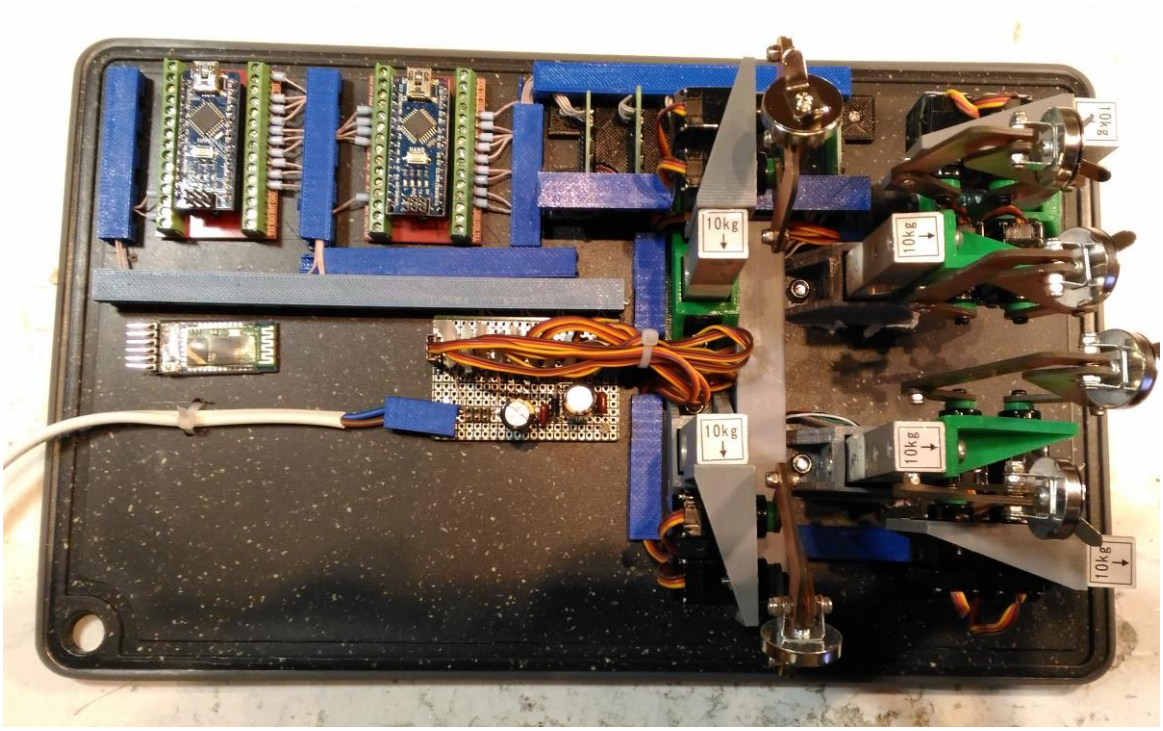

We took plastic breadboard and install 5 blocks on it, for example it is left hand drawing, L – for the right hand.



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




## Programming

Program code is Arduino IDE compatible. You can download code from git hab https://github.com/DrOnkel/Rehab/tree/ReHab0 or Hackaday project file section.

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.