

# POST STROKE SPASTICITY REHAB HELPER

## Build instruction V. 01

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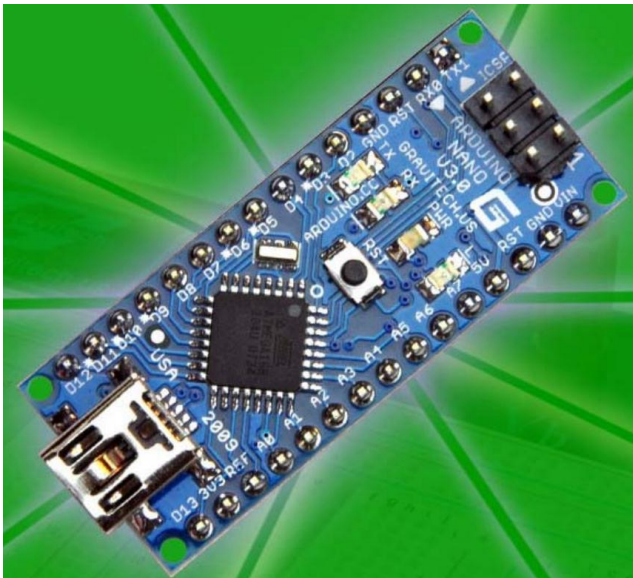
### Bill of Materials

We use in the project the components

No	Q	Name	Description
1	1	Controller	Arduino nano R3
2	2	8 digits LED shild	max7219 0,36"LED shild
3	2	Push button	Any push button- momentary
4	10	Servo mini SG90	Servo mini SG90 9g Tower Pro
5	2	5 kohm potentiometr	Any type of linear potentiometr
6	5	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.

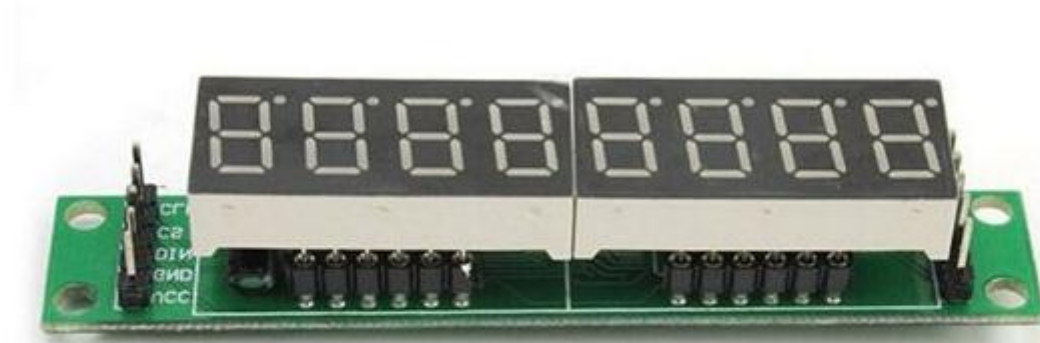
1. Controller Arduino Nano R3.x (992-ARD-NANO30NP) or any Arduino Nano R3.x compatible.



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

## 2. 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.



## 3. Push button

You can use one any momentary normal open push button, and one toggle push button.



#### 4. Servo SG90 9g Tower Pro



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

#### 5. 5 kOhms potentiometer

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

6. Magnetic Button Clasp Snaps

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



7. Shottky Diodes

1N5817 Diodes.

8. 3300 uF 16 V capacitor Low ESR capacitor.

9. 0.1 uF 16 V capacitor

10. Low base for servo. All holders and lever arms for servos (components 10 – 14) are described in “Mechanics”.

11. High base for servo

12. Servo mounted lever arm. Big hole must fit servo shaft.

13. Short node lever

14. Long node lever

15. Breadboard

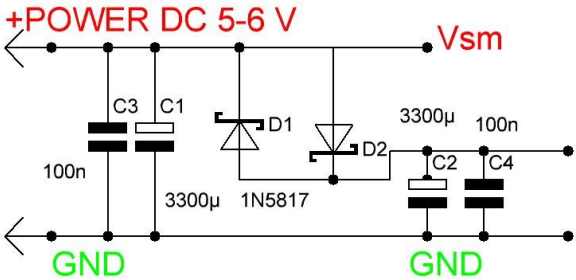
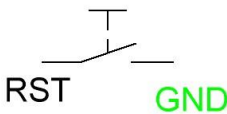
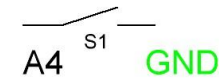
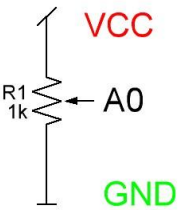
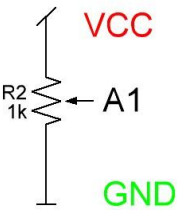
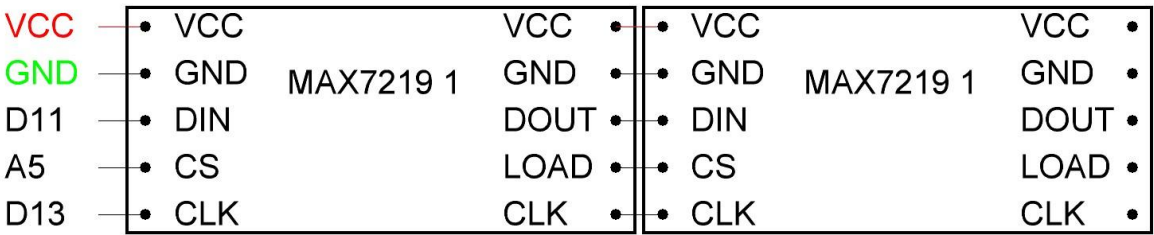
We used plastic cutting board, but any flat surface can be used.



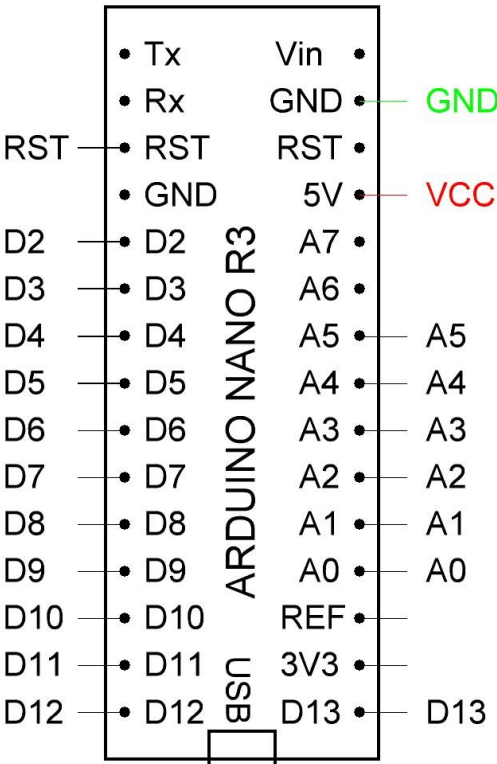
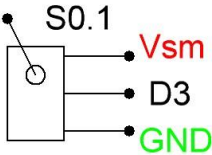
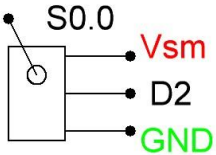
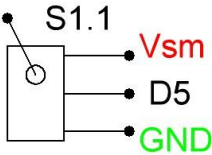
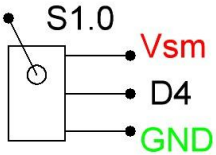
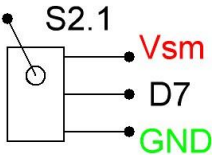
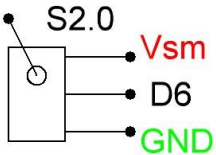
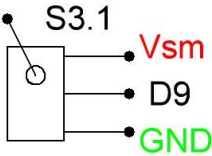
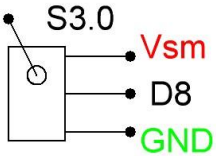
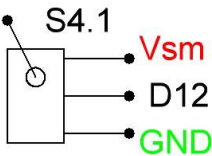
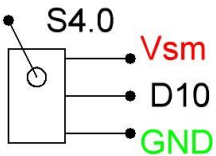
16. Nuts, screws and washers

# Schematics

## 5 CHANNEL 5 BAR LINKAGE LED 8X2



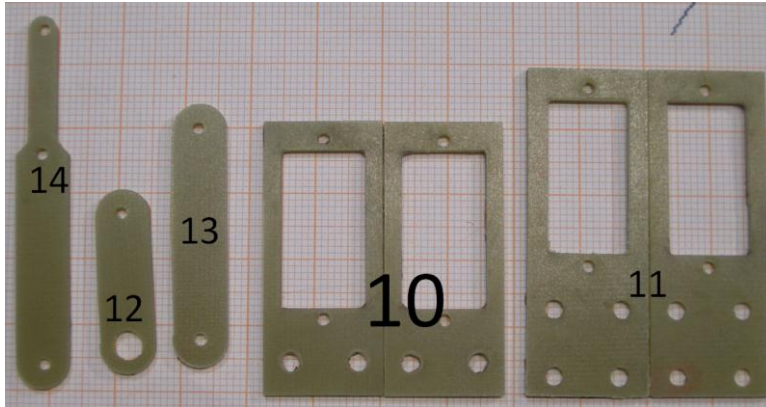
VCC



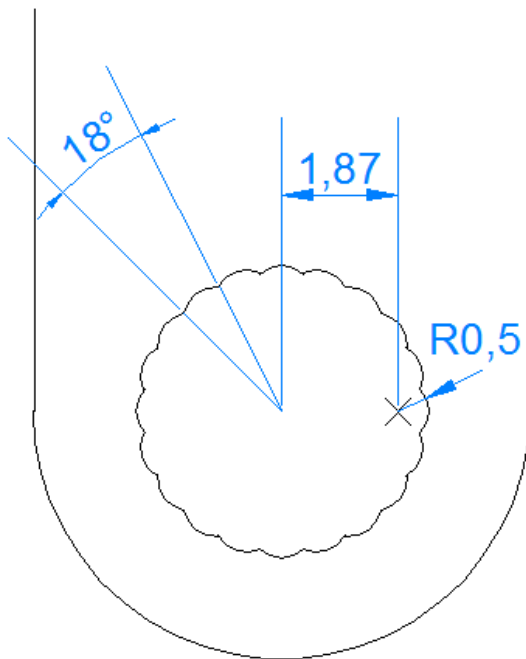
Peak power current can reach 2 A, so You have to use appropriate power supply. Not all computer USB connectors can give 2 A, so please be careful.

### Mechanics

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

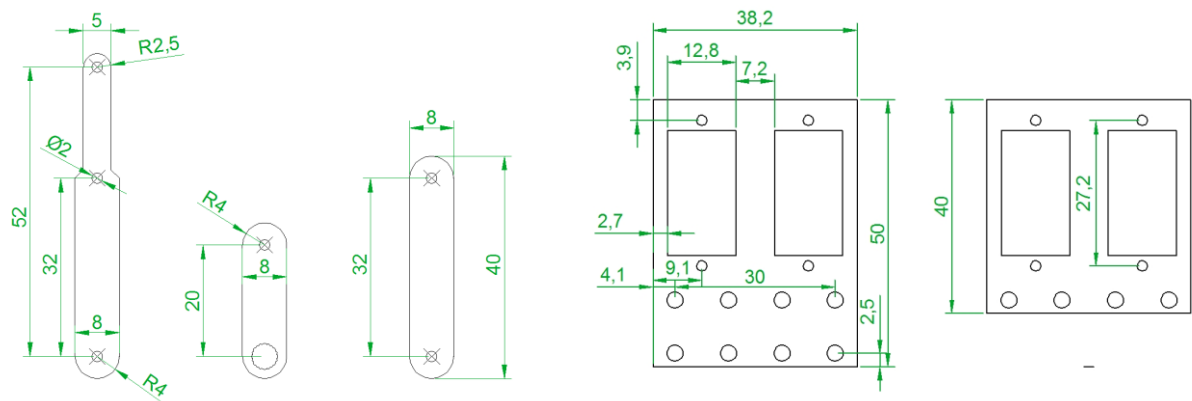


The only difficult part of mechanics component fabrication is lever arm 12. The perforation on arm must fit servo shaft perforation. We make perforation by drilling 20 holes via  $18^\circ$  (our servo shaft has 20 teeth) with 1mm radius drill with centers on the  $R=1.87$  mm circle.

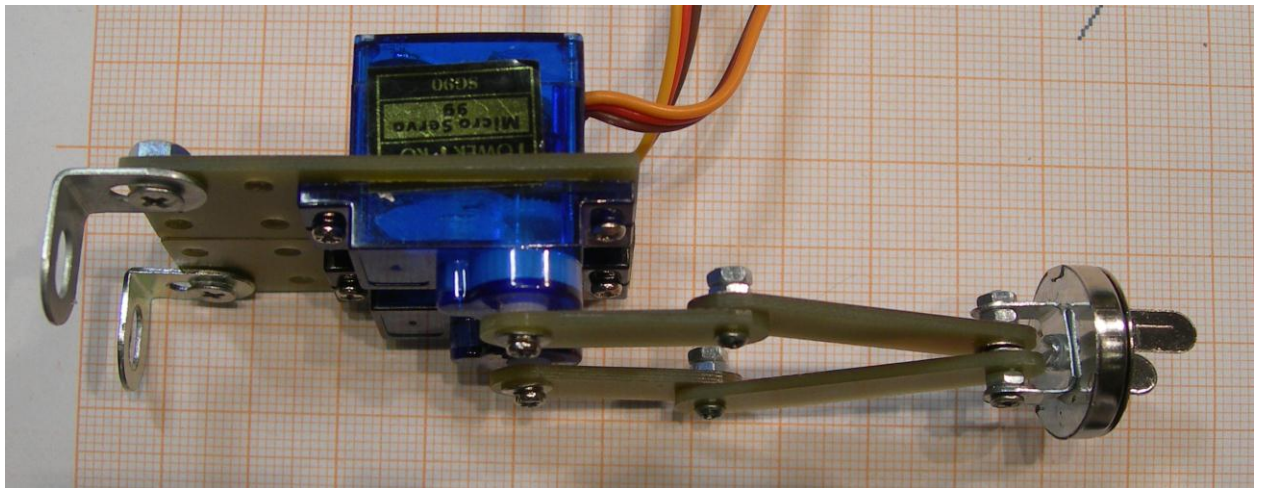
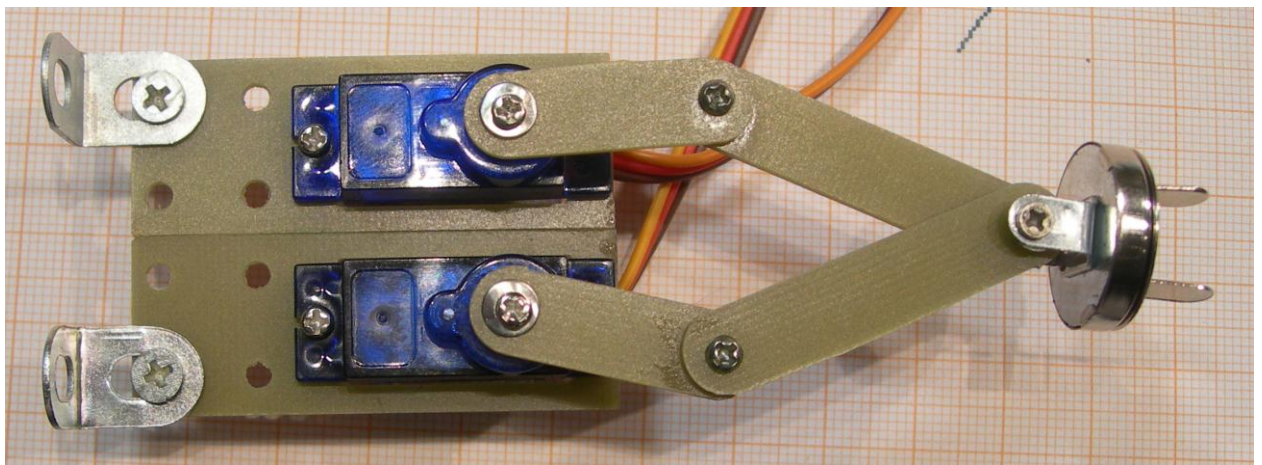


The drawings of lever arms and bases are here

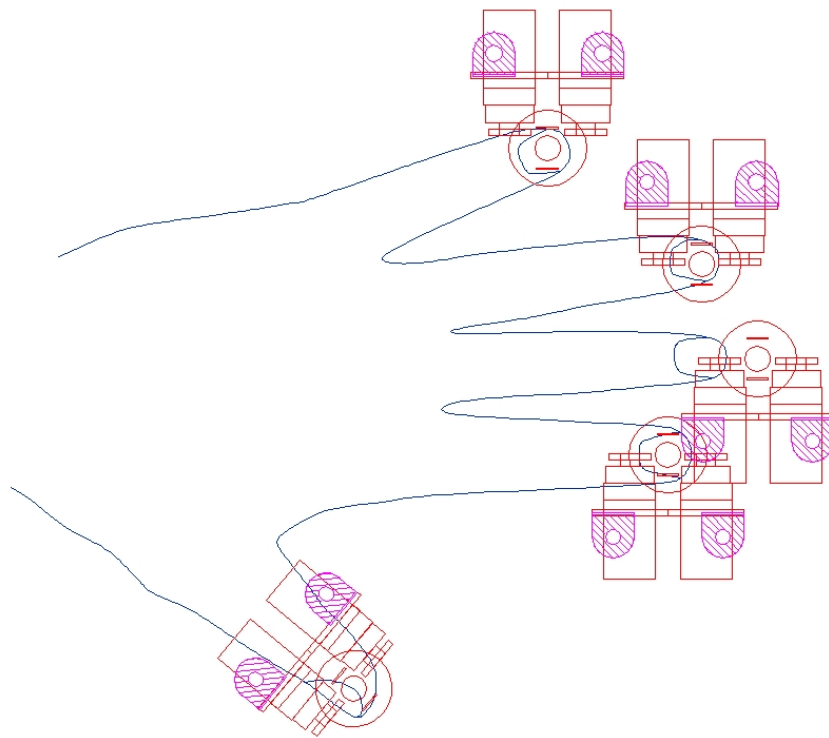




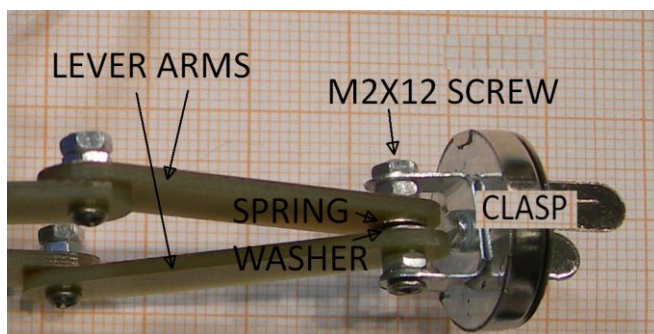
The size of components are defined by the servo in use. We made all drawings for Servo mini SG90 9g Tower Pro. Here is one block



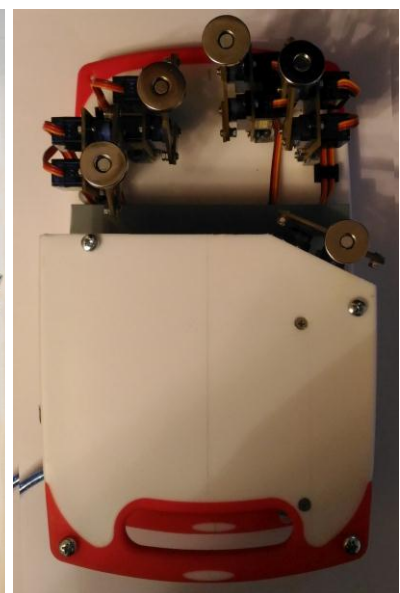
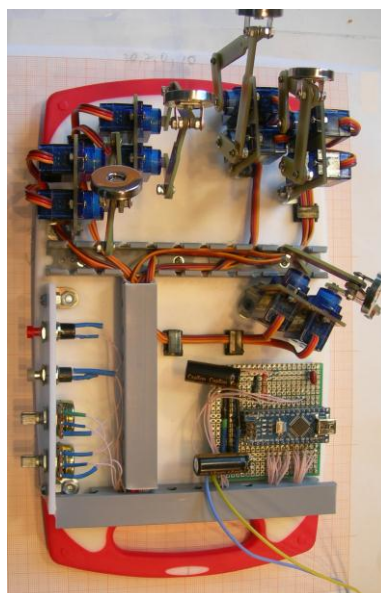
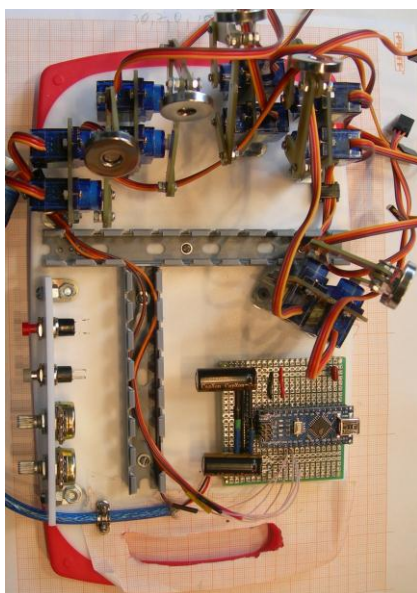
We took plastic breadboard and install 5 blocks on it, for example it is left hand drawing



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](http://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.