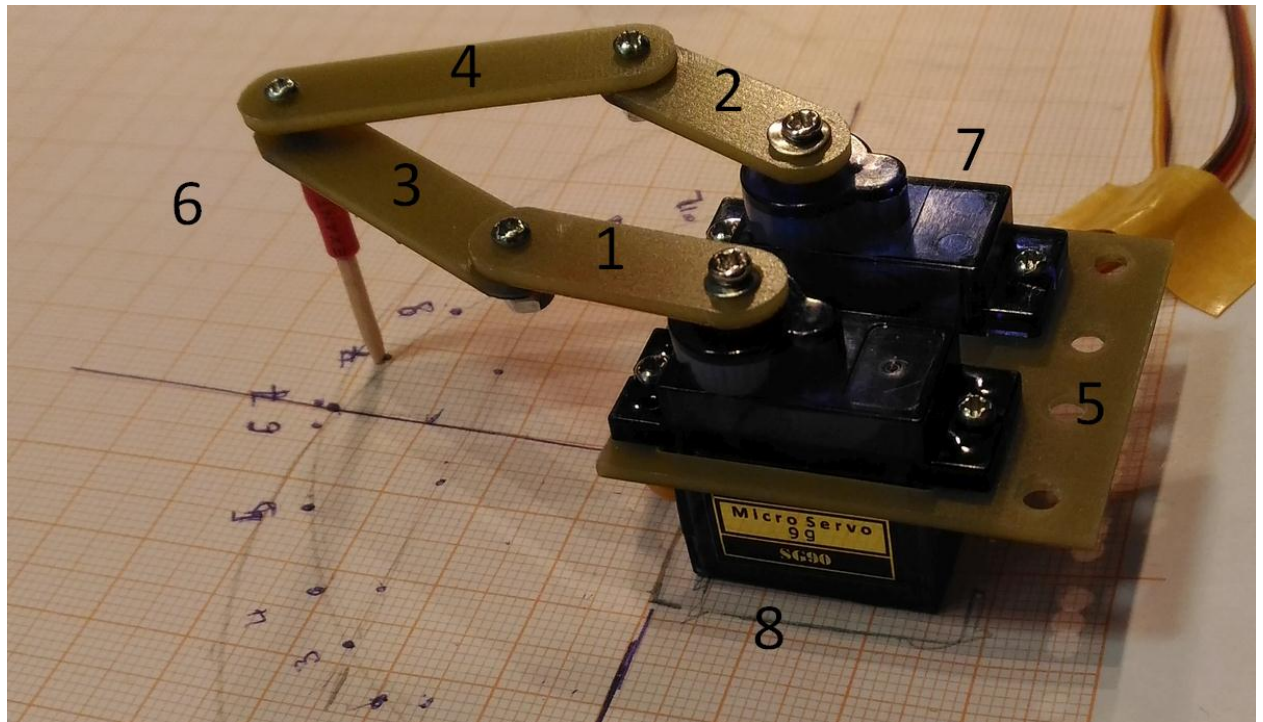


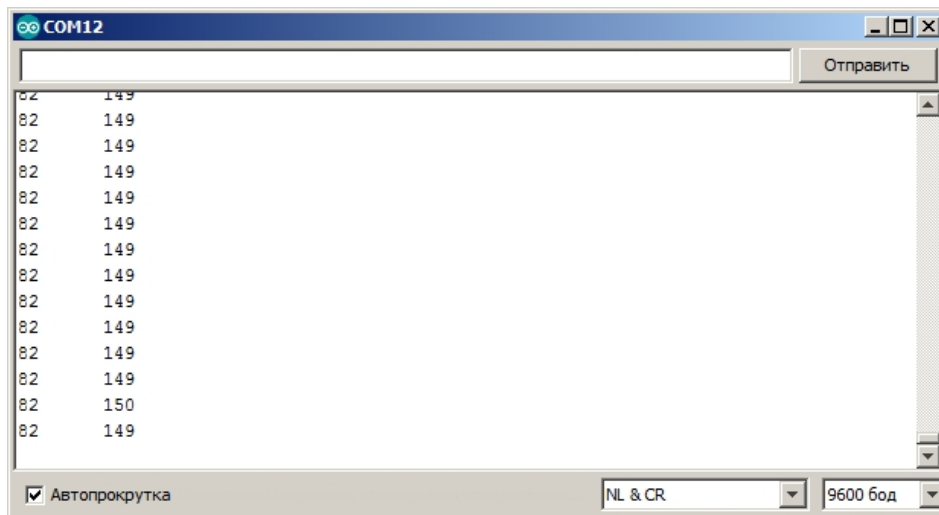
ReHab Helper - Program comments and math

5-bar linkage

We use 5-bar linkage for 2D- movement. Two servo (7,8) rotate two lever arms (1,2), coupled with secondary lever arms by screw and nuts. Other ends of secondary lever arms coupled by screw and nuts too. In test system pointer is linked to this joint. The system of lever arms can rotate in all joints. The pointer can reach any point in area between two semicircles with radius= $L1+L2$ with centers in the middle of servo shafts. We connect servos to Arduino controller and



download ServoPot2Tester.ino program. We rotate potentiometers until the pointer is in the point we need. On monitor we can see the values of servo angles, we denote this angles as ϕ_i and ψ_i .



Write down the data for all 8 points of the path. You can insert the data in arrays of the program, in the array x ($x=1,2,..7$) $Massx[8][2]$ in the order $fi_0, psi_0, fi_0, psi_0, \dots, fi_7, psi_7$, and for the reverse array $Massxr[8][2]$ in the order $fi_7, psi_7, fi_6, psi_6, \dots, Fi_0, psi_0$. You can insert data for any or all arrays instead of our default data. Modes 7 -16 are the same but with thumb movement. The Mode 17 is only thumb movement.

The program

Let us see the main parts of program. From the beginning.

You have to load LedControl library to you Arduino IDE program, please find it on <http://playground.arduino.cc/Main/LedControl>.

We use servo library from Arduino IDE program, the servo library is as a rule installed in core IDE.

Arduino controller calculate intermediate points within 8 points of the array. It makes the servo movement smooth and without jerks. The number of intermediate points can be from 3 to 35. The more the number the slowly moves the lever arms.

In the end of a program is a code for serial output of some data, it show the Mode, i and ns – number of point and of iteration within the points, Fi and Psi – angles of servo, Timer – time in milliseconds between the movements, Frames – quantity of iterations within the points, and Wipes- total wipes done.

```

COM12
Mode= 3 i= 0 ns= 2 Fi= 98 Psi= 63 Timer= 5Frames = 12Swipes=79
Mode= 3 i= 0 ns= 3 Fi= 97 Psi= 64 Timer= 5Frames = 12Swipes=79
Mode= 3 i= 0 ns= 4 Fi= 96 Psi= 65 Timer= 5Frames = 12Swipes=79
Mode= 3 i= 0 ns= 5 Fi= 95 Psi= 66 Timer= 5Frames = 12Swipes=79
Mode= 3 i= 0 ns= 6 Fi= 94 Psi= 67 Timer= 5Frames = 12Swipes=79
Mode= 3 i= 0 ns= 7 Fi= 94 Psi= 67 Timer= 5Frames = 12Swipes=79
Mode= 3 i= 0 ns= 8 Fi= 93 Psi= 68 Timer= 5Frames = 12Swipes=79
Mode= 3 i= 0 ns= 9 Fi= 92 Psi= 69 Timer= 5Frames = 12Swipes=79
Mode= 3 i= 0 ns= 10 Fi= 91 Psi= 70 Timer= 5Frames = 12Swipes=79
Mode= 3 i= 0 ns= 11 Fi= 90 Psi= 71 Timer= 5Frames = 12Swipes=79
Mode= 3 i= 1 ns= 0 Fi= 89 Psi= 72 Timer= 5Frames = 12Swipes=79
Mode= 3 i= 1 ns= 1 Fi= 89 Psi= 72 Timer= 5Frames = 12Swipes=79
Mode= 3 i= 1 ns= 2 Fi= 88 Psi= 73 Timer= 5Frames = 12Swipes=79
Mode= 3 i= 1 ns= 3 Fi= 87 Psi= 74 Timer= 5Frames = 12Swipes=79
Mode= 3 i=
  
```