



Maestría en Ingeniería en Automatización de Procesos Industriales

**Design of an orthosis for rehabilitation of
fingers of the upper limb for people with a
recent cardiovascular event**

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Design of an orthosis for rehabilitation of fingers of the upper limb for people with a recent cardiovascular event

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1. Introduction

This work presents the design of an electronic rehabilitation orthosis for the index finger and thumb of the left hand, for people with recent cardiovascular problems, which present muscular dystrophy as a consequence of the cardiovascular event suffered, and the joints in the hands and feet they contract, so it is necessary to rehabilitate their members to avoid complete loss of mobility.

The design performs 3 different exercise routines for different levels of rehabilitation, which can be selected by the user.

2. Objectives

2.1. General objective

To design a rehabilitation orthosis of the index finger and thumb of the left upper limb, automating various sequences of exercises.

2.2. Specific objectives

- To redesign the orthosis to perform rehabilitation exercises of the index finger and thumb.
- To simulate the control routines and implement them in a PIC18F4550 microcontroller.

3. Methods

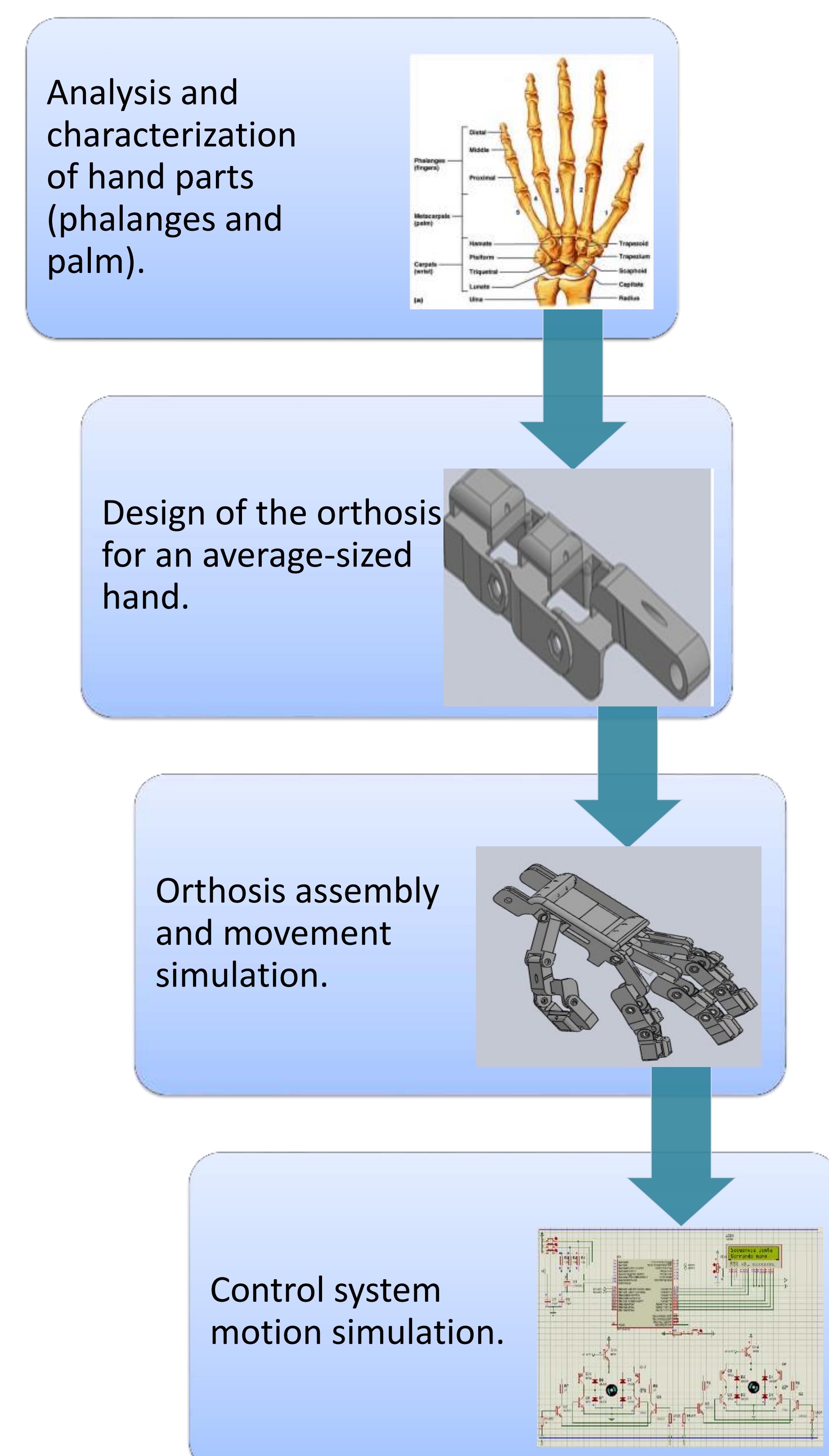


Figure 1. Methodology used in this research.

Left Hand bones

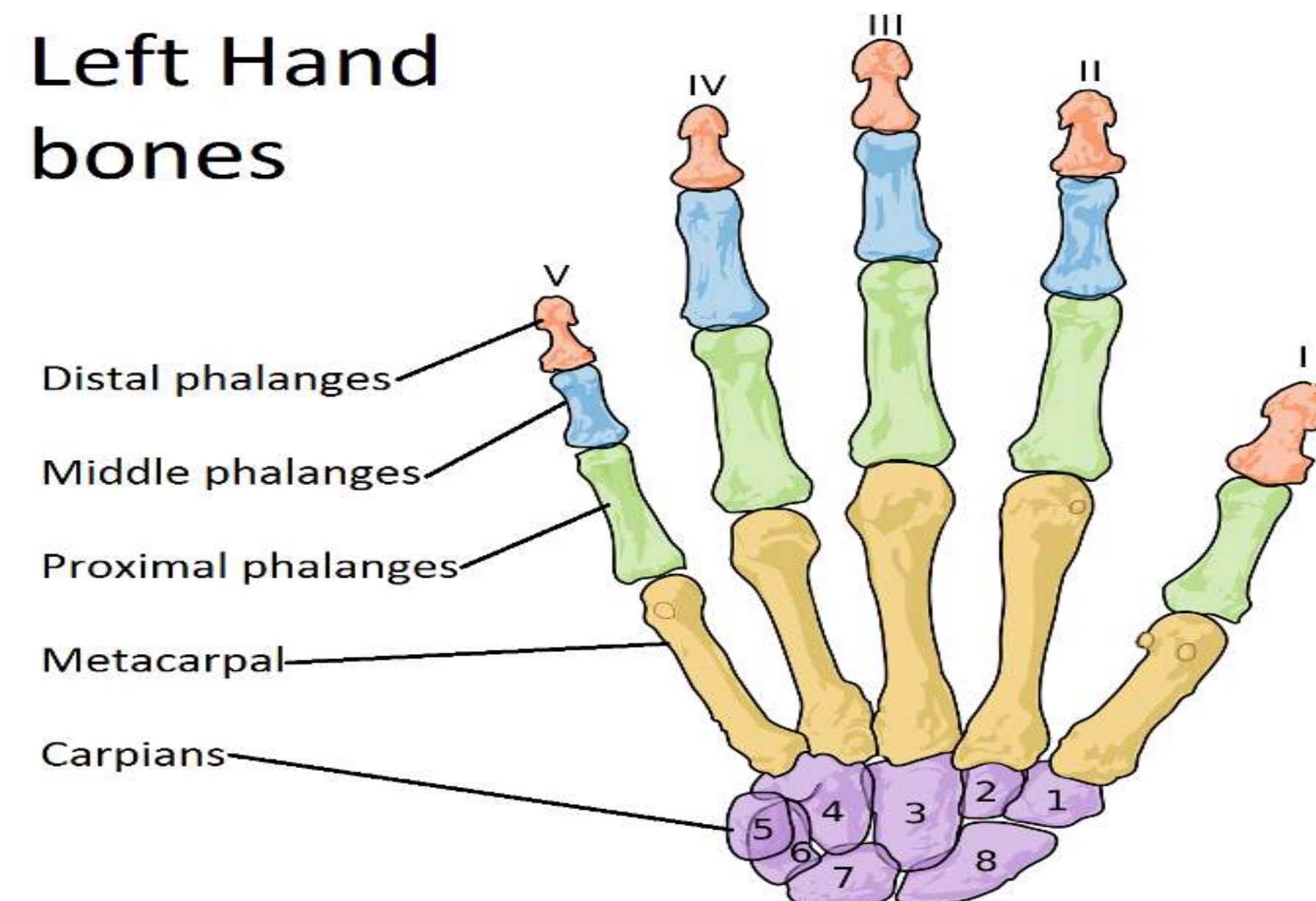
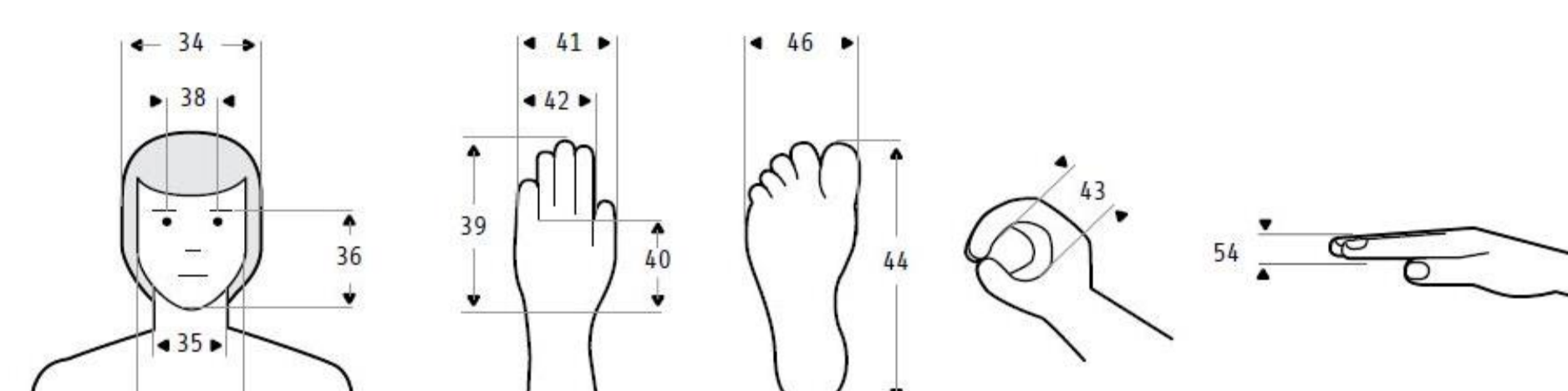


Figure 2. Structural bones of the hand [1].



Dimensiones	18 - 65 años (n=396)				
	\bar{x}	D.E.	5	50	95
34 Anchura cabeza	150	8.54	134	151	165
35 Anchura cuello	110	7.94	97	109	122
36 Altura cara	127	7.55	114	128	138
37 Anchura cara	124	9.69	106	124	139
38 Diámetro interpupilar	57	4.94	49	57	65
39 Longitud mano	171	8.28	158	170	185
40 Longitud palma mano	97	4.77	90	97	105
41 Anchura mano	93	6.83	83	92	103
42 Anchura palma mano	76	3.56	71	76	82
43 Diámetro empuñadura	44	3.63	39	45	50
44 Longitud pie	232	10.13	217	232	250
46 Anchura pie	90	4.92	83	90	99
54 Espesor mano	29	3.17	24	30	35

Figure 3. Table of measurements in millimeters of the parts of the hand [2].

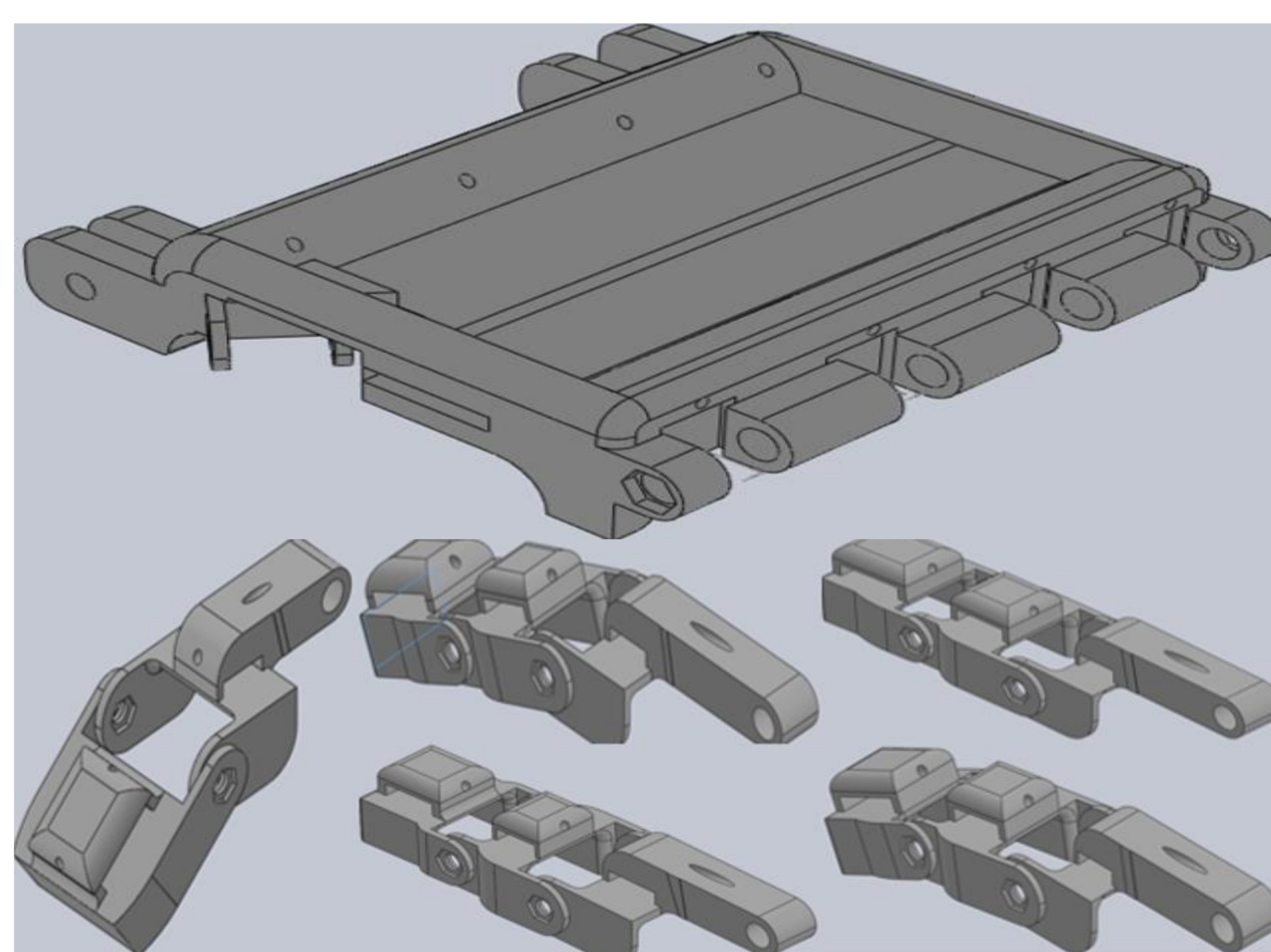


Figure 4. Hand's base and fingers design.

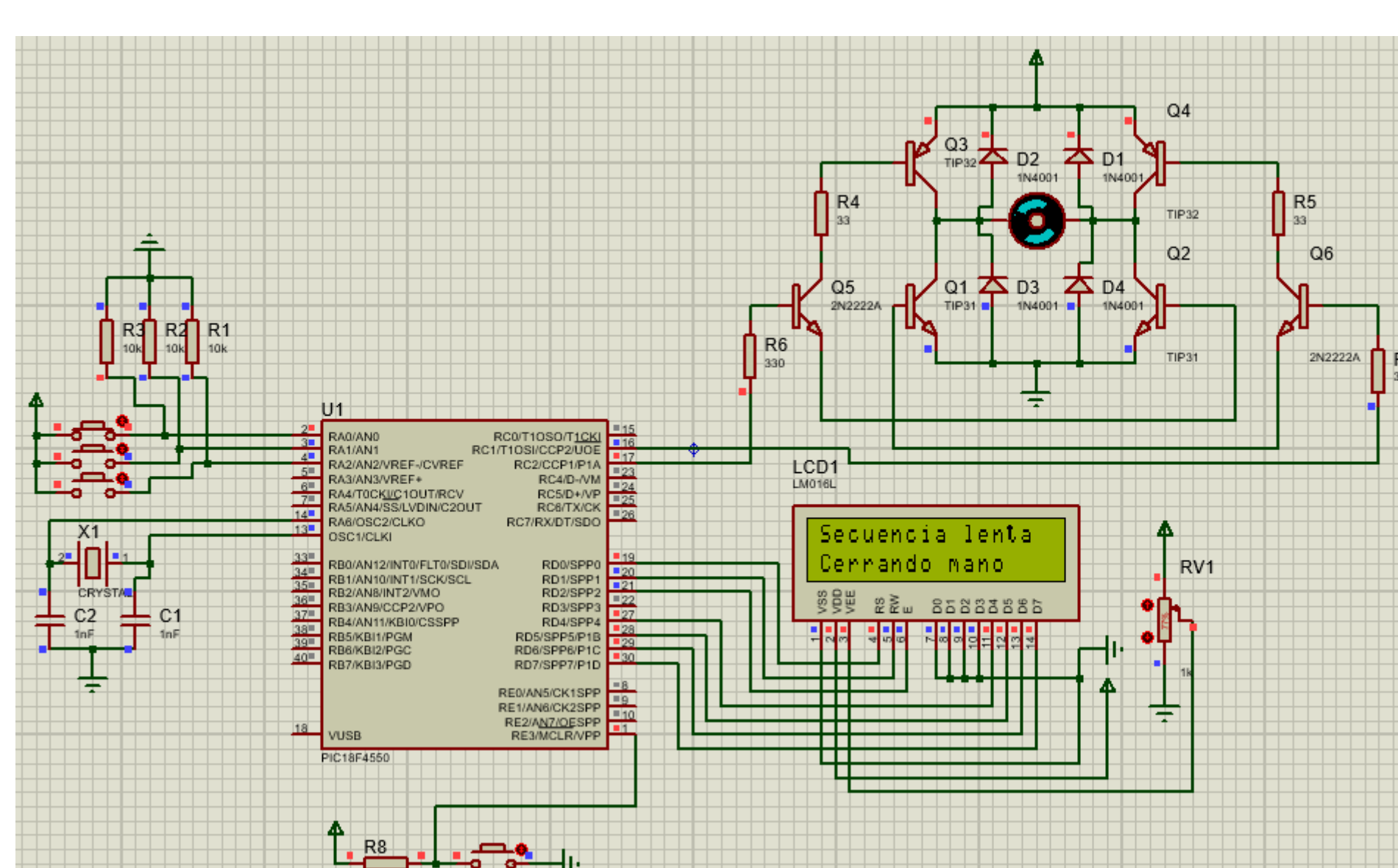


Figure 5. Test of operation with a motor and LCD screen.

4. Results

The simulation results show mobility mechanical assembly of all parts of the orthosis and control activation and change of rotation of the engines.

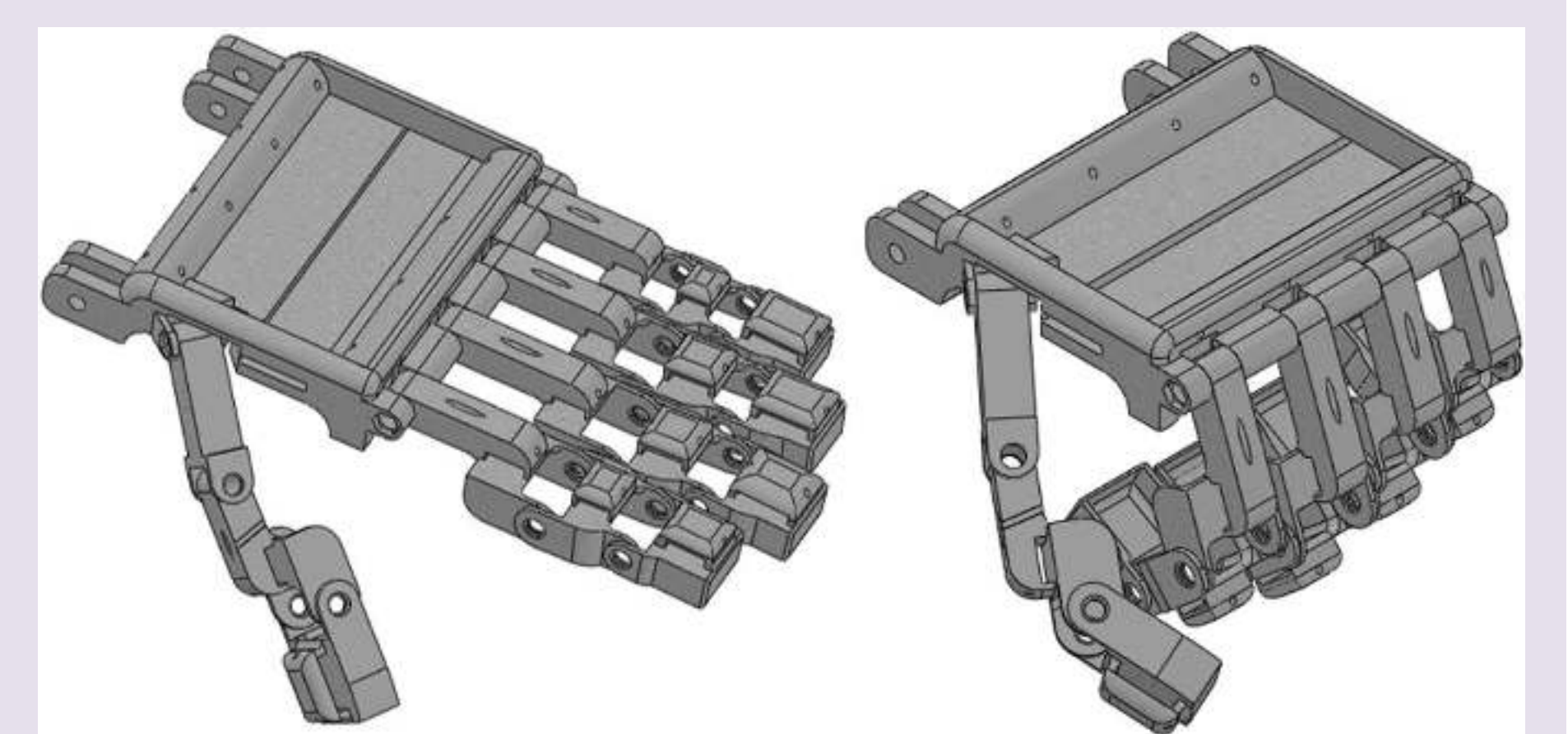


Figure 6. Orthosis of the left hand in open and closed position.

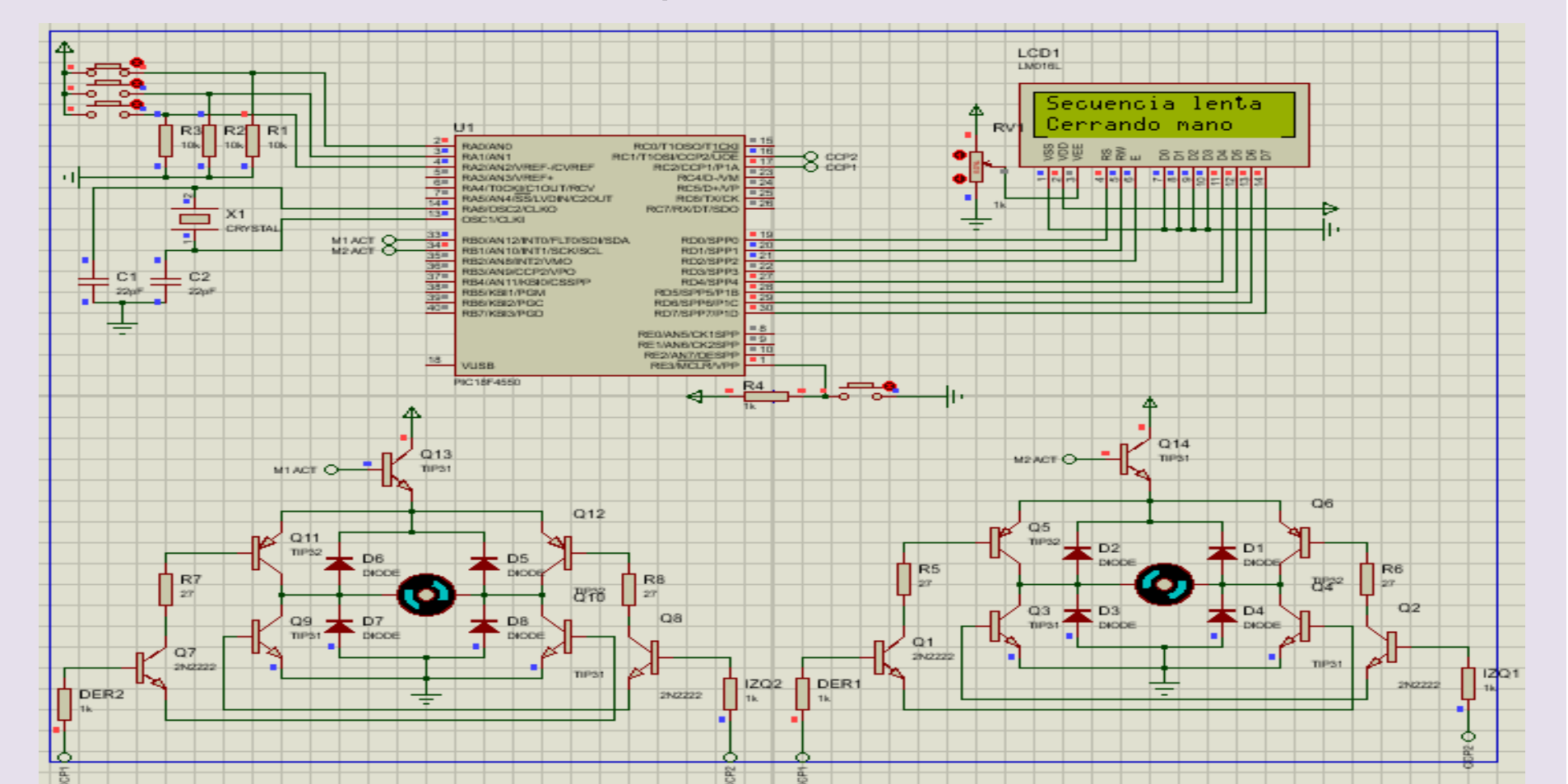


Figure 7. Control circuit simulating the three exercise routines on the index finger and thumb with change of speed and rotation.

	Index finger		Thumb finger	
	Movement	Time (s)	Movement	Time (s)
Routine 1	Opening	15	Opening	15
	Closing	10	Closing	10
Routine 2	Opening	8	Opening	8
	Closing	6	Closing	6
Routine 3	Opening	8	Opening	8
	Closing	6	Closing	6

Figure 8. Table of times and movements of the three routines.

5. Conclusion

The two objectives proposed in the work were met; the complete design of the hand was achieved, and according to the second objective, three rehabilitation routines were proposed, which were simulated and implemented in a microcontroller.

Future work:

To implement the control system in the designed orthosis, and test it in patients with a recent cardiovascular event, in order to measure the efficiency of it in its rehabilitation.

Acknowledgements

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References

- [1] C. Q. Burgos and O. A. V. Albán, "Diseño y construcción de una prótesis robótica de mano funcional adaptada a varios agarres," Popayán, enero del, 2010.
- [2] R. Á. Chaurand, L. R. P. León, and E. L. G. Muñoz, "Dimensiones antropométricas de población latinoamericana." Universidad de Guadalajara, CUAAD, 2007.



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