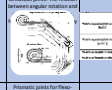
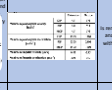
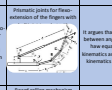
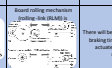
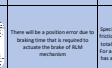
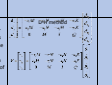
Type of product	Project		RDM		Mechatronics Characteristics									Portability			Security		Ergonomics			Perception					Affordability			
	Project Name	Image	Name	DoF	Type of Movement	Range of Motion	Mechanisms	Kinematic	Force	Torque	Actuators	Sensors	Control System	Communication system (cable and digital)	Power system	Weight [kg]	Dimensions [mm]	Portability	Obstacles/ Restrictions	Problems/ difficulties in the use of external factors	Type of clamping	Handling or adjust of the anthropometric dimensions	Noise	Aesthetics	Design Language	Color	Texture	Visual Impact	Sensory perception	Price	Production process	Maintenance	Materials
Productos grises / académicos	IntelliArm		2	Passive and active	Passive measurement in healthy patient: flexion/extension from 10° to 50°	Four bars mechanism. The bars L1 and L2 have adjustable length. L1 is driven by a motor with a flexible transmission	Ne	Ne	Passive measurement of a healthy patient: from -0.5 to 1.5 [Nm]	Driven by a unique motor	Torque sensors	The control system integrates sensors to give feedback and determine the position of the hand at all times	Cannot be teleoperated, although it was not the main focus of the research	Ne	Ne	190x90x150	None	Ne	The latent dangerous movements are restricted from software.	Metallic structure	Adjustment metallic surfaces and velcro belts	Ne	A heavy and robotic structure is evident, with visible mechanic and electronic components.	The design was focus on robotics and functionality.	Gray with black belts	Smooth	Too heavy	Low due to the size of the machine	Ne	Pieces cutted with laser, TORNO for shafts, and plastic splint for fingers.	Ne	Stainless steel, plastics and velcro
	HIT-Glove		2 DoF per finger + 2 DoF metacarpal base, adjustable	Only active is mentioned, but its architecture allows passive therapy	Ne	It is a combination of two mechanisms, a pinion-rack and two pinnuts/ screw, additionally, it has an adjustable metacarpal base to accommodate adductions and adbductions	Ne	Ne	From the motor characteristics, around 2 to 5 Nm	1 DC Motor DC for each joint	Force and position sensors	A control with feedback base on FPGA. The interface allows to see the data from the position and force sensors.	Ne	Ne	Ne	From visual inspection, Its size is acceptable for portability, although the election of materials may contribute too much weight	Yes	Ne	The therapist can interfere at any given time during the rehabilitation.	Metallic structure	Metallic structure	Ne	We observe a heavy metallic structure as base for supporting the arm, a rigid arm, likewise heavy for the dorsal part of the hand and robust mechanism for the fingers	The design of this machine is mostly orthogonal, robust and heavy	Gray	Smooth	Too heavy	Low due to materials and weight applied	Ne	Fine mechanics, cutted with laser y doblar láminas	Ne	Sheets of stainless steel, bronze gears
	MITMANUS		8 DoF, because it is physically impossible to move PIP and DIP separately, and abductions	Passive and active	Index finger MCP: 45° Ext, 90° Flex; Index finger PIP: 0° Ext, 110° Flex; CMC: 20° Abd, 45° Add; Thumb CMC: 20° Ext, 60° Flex; Thumb MP: 10° Ext, 60° Flex; Thumb IP: 20° Ext, 90° Flex	Uses a mechanism of dual viela and slipper. In sum are 8 DoF and these mechanism in star shape	Ne	Ne	Ne	Rotatory electric motor without brushes	Position sensors y speed	Ne	Puede ser teleoperado pero no es ejes temático de la investigación	Ne	Ne	Ne	Ne	Yes	30-135° por medio de topes mecánicos	El dispositivo es retrosilmentado y tiene un software que limita el control del robot	Metallic structure	Metallic structure	Ne	The appearance of this machine is robotic, rigid and focused on the role	Emulates a joystick	Gray	Smooth	Mechanic game	Medium due to few interaction with the patient; non invasive	Ne	Ne	Ne	Sheet steel , plastic covers and steel turning
	ReHaptics Ib		2 DoF. One moves the fingers in flection/extension; the other rotates the arm in pronip supination	Passive and active	30-200 mm forward; ±15º in rotation	The rotational movement becomes in translational through belting, with guides. The other movement is direct	It has q1 y q2 as general coordinates. Matrices of direct and inverse kinematics are set. The Jacobian matrix determinant is different from zero, therefore it has no singularities	Fuerza en Fingers is cerca 200 N, aunque el objetivo de nuestro caso es que sea 20 N, para que sea ergonómico. The minimum force is cerca 10 N	Less than 1 Nm for AVD	Two DC motors with gear reducers of 51 + 1 (M1-M2-M3-M4), 1000 CPR, 24V, Maxon motors and encoders, Maxon Motor	The motors are equipped with optical encoders (HEDL 5540 3000 cuentas/ turn, Maxon) Hall sensors (Maxon) Current sensors (ACS712 5A, Allegro) Force sensors (FSR 400, Interlink Electronics)	The boards have a microcontroller (Teensy 4.1, Pjrc) Bluetooth module (HC-05, Zhuhai Jinwei Electronics) Power management boards (custom)	Ne	Ne	Ne	Yes	Forward (30-200mm) and rotation of +/- 15º	The dimensions of the prototype grind the Bluetooth module (HC-05, Zhuhai Jinwei Electronics) Battery (Maxon) are selected with a delay of 2 weeks, so the dimensions are based on the suppliers of the custom parts. Security measures: in the software stops the power if the motor exceeds the maximum current. The program does not restrict the rotational movement. Mechanisms to prevent injury: removed the sharp edges the hinge cards	Plastic grips	Ne	Ne	It shows a rigid, robotics and heavy metallic structure	It is based on the functionality of the rehabilitation and the raised movements	Gray	Smooth	Anthropomorphic	Medium due to few interaction with the patient; non invasive	Ne	Fine mechanics, cutted with laser y doblar láminas	Ne	Aluminum, pulleys and accessories in high-density plastic, rubber belts
	Master Hand		3 rotations and 3 translations simultaneous and linear for each finger	Ne	Ne	Circulous joints: The relation between angular rotation and 		Is remarkable the stress analysis in the cable with the torque in the joints	Describes a method for calculating the torque	Motor (Faulhaber GmbhBCo., 1724SR)	Aphele reflector (Sanyo Electric Co., Ltd., SPI-5x5-142, a reflective sensor (Sharp, GP2S60), a force sensor (Interlink Electronics), and a steel fiber cancer (Bike components, Fuorfiore)	A type of one are presented in which angle, specifies and linear. In the first a lateral bearing because which exists a lateral movement of the cable, and the second is a bearing axial movement, because the axial shaft the information is corresponds to the actuator input to calculate the position of the joint. The information is used to calculate the position of the hands. The information provides the position of the joints, the information is used to calculate the position, the position is measured by sensors and outputs the information to the PC. The PC uses the information to calculate a new. The other formula, wants to establish relation with the force in hand with the same control strategy which the force, sensor measure with the force	Ne	Ne	Ne	Yes	Ne	N.E.	Plastic surfaces	The links are adjustable connecting screw position	Ne	We observed a product with an orthogonal structure, color that manages to convey through the concept of lightness	Its design is based on joints and the joints of the fingers, understanding them as independent mechanisms	Blue	Angular	Atractive by color	Medium due to the machine color	Ne	Plastic extrusion and machining of metallic parts	Ne	Polyethylene of high or medium density, stainless steel and aluminum
	The Rutgers Master II		5 DoF per finger, 1 Loy prismatic, y in the palm, the cylinder can rotate on its shaft and the fingertip can rotate about the shaft	Not specified but is capable of doing passive movements and feedback in a virtual environment	From -10° to 120° in flexo extension, and more or less 60 ° abduction-adduction in MCP. And 45° in flexo-extension in PIP	Prismatic joints for flexo-extension of the fingers with 	It argues that there is a relationship between angles in PIP and DIP. The have equations describing the kinematics are nonlinear and inverse kinematics is solved by iterations	16 N in each finger (there is not for the little)	Ne	Pneumatic actuator Kloki-ND	An ethical sensor measures the position of the joints, and a force sensor measures the force of abduction/adduction	The hands are in reference to the pointing accommodates the hand, the hand is attached to the arm, the arm is attached to the chair. The accommodates signals to the controller of the robot which is the computer. The computer controls the robot.	Protocolo serial RS232	Ne	0.8 in the excoskeleton +0.105 in cables and capsules cylinders	Smaller than the size of the palm	Yes	The actuator flexion varies from 10° to 120°	N.E.	Plastic grips	Plastic grips	Ne	Note a lightweight, single-gimbal mechanism, with its mechanisms and functionality uncovered	This object is based on the function of flexion of the fingers and place this function in a simple way	Gray	Smooth	Perception of control	Low due to the type of fastening	Ne	Machined parts	Ne	Metal and some plastic parts.
	Portable CPM		4 DOF per finger.	Passive and active		Board rolling mechanism (rolling link (RLM)) 	There will be a position error due to braking time that is required to actuate the brake of RLM mechanism	Special emphasis on the friction force is made. In total has 4 N in frictions For active mechanism, It has a force of 2N brake		Brushless DC motors are suitable for haptic interfaces , since they have a high response to handling, low friction, low inertia and torque can be controlled	An encoder on the boards and potentiometers for measuring the angular position	Ne	Ne	Ne	Ne	Yes	Ne	N.E.	Fabric belts	Cloth straps	Ne	Robotic and heavy structure with its mechanisms and electronic components in sight	We can tell that its concept is based on the function and mechanism of the fingers	Gray with black	Rough by straps	Perception of pressure and pain	Low due to how the element tight and restrict the individual	Ne	Machining of parts and woven fabrics of synthetic fibers	Ne	Polymeric fibers and metals.
	CPM y CAM device for hand		2 DoF. In PIP and in MCP	CPM and CAM (continuous active motion)	0-90°		Ne	Ne	4.5 Nm	Two MicroMo DC motorswith planetary gear train of 246:1	Each Joint has two Rotaforce potentiometers (Vishay Spectrol) acting in hand-scale. The Rotaforce are planned in the sensors that are in the joints of the exoskeleton. There is a potentiometer, an analogue encoder measures the position	The robot arm is made by the 3D printing, and it is modular, flexible, safety and reconstructable. Locking: Locks the joints in a specific position, so the patient can't move from the secure. The secure mechanism locks the joints in a specific position, so the patient can't move from the secure. Limiting: Limits the range of motion to prevent injuries. Safety stops: Automatically stops the motors if a problem is detected.	The communication between the patient and the mechanism is through three recipe switches and a LCD Display	Ne	Ne	Ne	Ne	No	Design has a range of motion from -90 ° to + 90 ° for MCP and PIP	An emergency stop button is easy to hide, and it is extremely beyond the normal position. Design characteristics is easy. But this mechanism is operating only right hand	Metallic structure	Ne	Ne	Note a metallic and heavy structure which does not communicate well its functionality or its use	No clear evidence of a design concept	Gray	Smooth	Perception of heaviness	Medium because it does not involve having something over the patient	Ne	Molds for metal and machining parts	Ne	Metals such as stainless steel and aluminum
	Exoskeleton system for index finger rehabilitation		3 DOF per finger.	Passive and active	In flection: DIP of 0-80° PIP from 0 to 100°, MCP from 0 to 85° / In abduction-adduction MCP from 0 to 45°	Parallelogram mechanism, driven by Bowden wires	The moment of inertia (MOI) has a significant impact on the performance of the system, especially on backdrivability when the device is used in the active-assistive mode. Minimizing the MOI is crucial for ensuring as the haptic device will smell inertial is pressed.	N. d.	In flexion: DIP 0.17, PIP 0.29, MCP 0.26. / In abduction-adduction MCP 0.20	Four potentiometers (Murata SV01A103) to measure joint angles and force sensors (Honeywell, FFQ to measure the force exerted on fingertips	Four DC motors	A computer is used to send references to the controller which continuously exhibits an unbalanced, the controller receives the information from the sensors and calculates the force to be exerted on the fingertips. The computer receives the force to be exerted on the fingertips and calculates the motor commands (PWM , Pulses) and sending signals corresponding to the motor commands to the motor controllers via the serial port. The controller receives the corresponding motor commands and signal feedback to the controller and so you can keep control in time.	USB Protocol with a frequency of sampling of 100Hz	Ne	0.16	Ne	Ne	No	DIP 74.2°, PIP 90.8° and MCP 77.8°	As the tactical prevention to the mechanical stress is impossible a rigid structure is not adjustable. Velcro straps is used to type a ergonomic	Velcro tapes on each finger	They are adjustable by two screws to move along a slot	Ne	We denote one disproportionately large and robotic structure	No clear evidence of a design concept	Gray with black	Angular	Perception of control and may be heavy	Low due to heaviness of the object .	Ne	Plastic extrusion, machining parts and tissues	Ne	Most aluminum
	Finger Exoskeleton		4 DOF per finger.	Passive	Ne	Uses a circular scissorlike screw drive to transmit motion from a motor to the joints. The screw mechanism provides a gentle, smooth, and flexible actuation. Its simplicity thus ensures reliable performance and ease of maintenance, making it an ideal choice for wearable assistive devices.	Rotation is around 17.7 rpm of MCP	Ne	Almost 1Nm	5 Brushed motor DC Portescape 17N78-2164 (Weight 17g, and the rated power of the motor is 2.2W)	Three encoders for measuring the angle of the joints, and force sensors (Flexiforce A201) and pressure sensors, an Elecfreaks MQ2 air motor pressure sensor, and an Elecfreaks Flame sensor for the safety of fingers	The motor controller module is composed of a pca9685 PWM driver, which receives commands from the Raspberry Pi via the I2C interface. The pca9685 then generates PWM signals and adjusts the PWM duty cycle, controlling the motor's speed and direction. The motor controller also integrates a DRV8833 dual H-bridge driver, which provides the necessary power and signal isolation for the Pi to safely control the motors.	Ne	Ne	Ne	Ne	Yes	Ne	Ne	Velcro tapes	Velcro tapes	Ne	A large and heavy mechanical components is noted for Finger	Note that it was based on the function of the finger joints	Gray with black	Rough by straps	Perception of subjection and control	Low due to the mechanisms are uncovered	Ne	Machining and tissues	Ne	Aluminum and synthetic fibers
	Finger Exoskeleton		3 DOF per finger	Passive	MCP 0-90, PIP 0-110, DIP 0-90, CMC 0 in flex-extension. For abduction adduction MCP -15/ 15°	Uses toothed belts (4) for transmission of torque, as well as a pair of gears in the joint PIP. The structure provides the anchor and a degree of freedom in each of the joints		Ne	Ne	BLDC motor (Maxon)	MR sensor, size of (Bourns) (Resistive), weighed 0.5g used to measure the angle of the joints, vibrometer, including gyroscope, speed and acceleration, a Bourns sensor (Resistive) and force sensor (Resistive)	We system is controlled by a microcontroller which is the core of the computer, responsible for processing the signals from the sensors and executing the control algorithms. The system uses an encoder connected to the motor to provide real-time feedback on the motor's position and velocity, ensuring precise control. The motor controller and driver circuit manage the movement of the motor based on the commands received from the microcontroller. The system also includes safety mechanisms, such as limit switches and overcurrent protection, to prevent damage to the motor and ensure safe operation.	Ne Likely a USB protocol	Ne	Ne	Ne	Ne	Yes	MCP from -37° to 57°	Ne	Metallic structure	Ne	Ne	It looks like a very heavy and large structure, considering the size of the Finger	Its based on the finger joints	Gray with black	Angular	Perception of mechanical parts in excess	Low due to the heavy mechanical design	Ne	Machining parts	Ne	Rubber bands and aluminum
	HWARD		3 DOF in total	Active (assisted and weathered) and Passive	Fingers: 0 to 5 MCP: -20 to 90° (+/- flexion, taking external angles from the hand) Thumb: Abduction-adduction: 0 to 45 Flexion and Ext: 0 to 90 Wrist: Flexion and Ext: 0 to 90 Ulnar and radial deviation: 0° / 10 flexion and Ext: 0 to extension	Uses pneumatic pistons coupled to movement of four bars to perform the movement	Ne	4-15 N, although the cylinders can reach forces 122.8N	Ne	A pneumatically actuated by 3 double-acting air cylinders with bore diameters of 1.59cm and 3-port pneumatic solenoid valves	Force/pressure sensors (Wikko Electronics) Hall effect sensors (Honeywell) Gripping force sensors (Wikko Electronics) Force sensors (Honeywell) Pressure/vacuum levels	The Arduino Uno is a little Mega, a Mega is a little Arduino. Arduino Mega (Microchip) Hall effect sensors (Honeywell) Force sensors (Wikko Electronics) Force sensors (Honeywell) Pressure/vacuum levels	MCP FLEXION 25 to 90° degrees in flexion, 75% - 90% for total thumb extension and the movement of	Manual Exoskeleton steps present hyperextension of the patient's joint, and the system must be able to detect and prevent this. Changing screws to a single screw is a good solution. The control software is the focus on a single group of number hundreds	Fabric belts	Cloth tapes	Ne	A structure with freedom for the joints of the hand , light and easy, is denoted	No clear evidence of a design concept	Gray with black	Smooth	Perception of control	Medium because does not involve subjection for each finger	Ne	Molding of metal parts and tissues	Ne	Rubber bands and aluminum
Productos comerciales	Kinetic Maestra Hand Portable		1 DoF en flexo-extensión de MCO	Passive	15° hyperextension to 270° Flexion (composite fist), for external angles	An motor mated to the link 1 for flexo-extension MCP. Transmition with pulleys in a second and third link to mobilize PIP and DIP	From 27 to 136 seg (cycle from 270 to 0°) (15 calibrations)	Ne	Ne	Ne	Ne	Ne	No	Independent form server	3.5	320x430x140	Yes	Ne	Foam protection	Adjustable splint with two belts with (recubrimiento acolchonado)	The wide of the metacarpian is adjusted with a moveable base. The length of the fingers can be adjusted as well.	Not noisy	The design of the housing is clean, simple general characteristics as a minimum amount of resources are used to generate the object appearance	It is a concept tied to functional but with simple characteristics , for example the composition of the hexute has aiment at stamping subtractions thereof	The brace has a smooth texture. The glove has a smooth finished and outlessned	White with gray and blue details	Smooth	Perception of lightness and ease	High due to gentle and simple design	£4091.29	Extrusion of plastics, fabrics and simple hardware	Ne	Thermoplastic, polymeric fabrics and some aluminum parts
	WaveFlex CPM		1DOF per finger (2 to 5)	Passive	MCP: 0 - 90°, PIP: 0 - 110°, DIP: 0 - 70°, full composite fist: 270° (external angles)	The motor shaft is coupled to a curve link that mobilizes the joints	30-120 seconds per cycle	3.5 lbs a 9.5 lbs	Ne	Ne	Ne	Ne	N.d	Ne	0.86	Ne	Yes	Ne	Ne	Adjustable splint on the arm with two straps on the padded coat	Fabric belts and plastic parts	Not noisy	The design of the housing is clean, simple general characteristics as a minimum amount of resources are used to generate the object appearance	It is a concept tied to functional but with simple characteristics , for example the composition of the hexute has aiment at stamping subtractions thereof	Black with gray and blue details	The brace has a smooth texture. The glove has a smooth texture and outlessned	Perception of security	High due to gentle and simple design	Ne	Fabrics and plastic extrusion	Ne	Thermoplastic, polymeric fabrics and some aluminum parts
	RESTO Expoland		3 DOF per finger (2-5), 4 DOF in thumb	Passive and active	Ne	Uses a pnumatic mechanism, and mechanism of four bars coupled	Ne	Ne	Ne	Ne	Ne	Ne	Ne	Ne	Ne	Ne	No	Ne	Ne	A polymeric material glove	Metallic parts	Sounds	It evidenced a clean robotic design with mechanisms in sight	A functional concept that understood in detail the joints of all fingers	Black with gray and blue details	The glove has a non-slip surface and joints of the machine smooth surfaces	Robotization perception	High because its mechanisms and design in general are well done	Ne	Plastic extrusion, machining parts and thermal processes for manufactur	Ne	Aluminum , rubber and plastics high or medium density
	Vector 1 CPM		1 DOF per finger (Fingers 2 to 5)	Passive	Ne	Uses only one rotary actuator (motor) and its shaft is coupled rigid curve elements that are tided to the fingertips	Ne	Ne	Ne	Ne	Ne	Ne	Ne	Ne	Ne	Ne	Yes	Ne	Ne	Cloth straps	Cloth straps	Ne	We see a structure composed of simple surfaces with different colors in its components	Note a concept based on the coating of the hand, trying to reach simplicity	Black with gray, green and blue	Some smooth parts and other cushioned	Perception of pressure	Medium, because despite being a commercial product, is not perceive a friendly design with the user	Ne	Tissues, plastic extrusion and some machined parts	Ne	Polymeric fabrics, aluminum and plastics
	CyberGrasp		2 DOF (1 passive-active, 1 DOF but no motion in DIP (for Fingers 2-5) 1 DOF in	Passive and active	Ne	Uses bowden wires	Ne	Ne	Ne	Ne	Ne	Ne	Ne	Ne	Ne	Ne	Yes	Ne	Ne	Cloth glove	Glove fabric and plastic parts	Ne	A heavy product, with its mechanisms in sight, large and muted color is observed	Note a concept based on highlighting the functionality of the mechanisms used to impart movement to the Fingers	Black and light brown	Padded glove	Perception of heaviness	Medium because despite it has a clean design, end up too heavy	Ne	Extrusion of plastics, fabrics and simple metal parts	Ne	Plastic, polymeric fabrics and some metals