



Document details

ID and title	D2.5
Description	Optimized device versions – 1
Work package	WP2
Type	Demonstrator
Confidentiality	PUBLIC
Actual date of delivery	2018-10-31
Contractual date of delivery	201Y-10-31
Project name	iHand
Project number	801945
Call	H2020 SME Instrument

Document history

Version	Date	Status	Changes	Editor
V0.1	2018-10-10	First draft	First draft	Martin Remning Wahlstedt

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1 Introduction

1.1 Purpose of this document

The purpose of this document is to demonstrate the glove deliverable in the project. This deliverable focuses on the iHand rehab glove, which is a further development of Bioservo's product Carbonhand®. It describes what the glove looks like, what it does and when and by whom it is supposed to be used. As the actual deliverable is a working device, this document gives a description of the demonstrator.

2 Demonstrator

2.1 Overview of the glove system

The glove is worn like a normal glove on the user's affected hand. The glove is connected to a motor and battery (power) pack via a cable. The glove and the power pack can be separated using a connector placed on the user's forearm. The power pack is fastened to the user's belt or waistband using a clip. The cable is kept close to the user's upper arm using an arm strap and the connector is kept close to the forearm using another arm strap.

The illustration below shows all parts of the system.

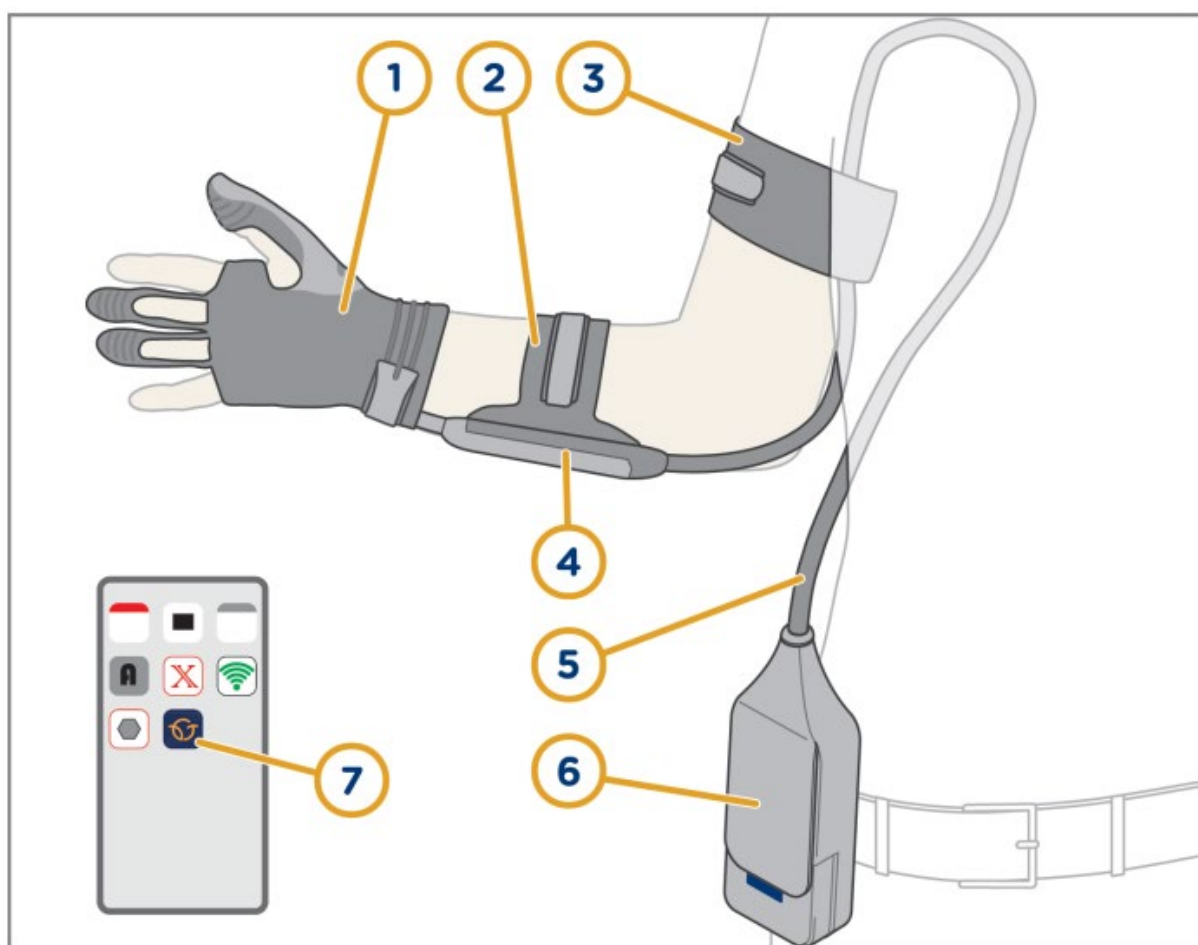


Figure 1. Carbonhand glove and power pack

Item	Name	Function
1	Glove	Provides grip force
2	Lower arm strap	Keeps the connector attached to your arm
3	Upper arm strap	Keeps the cord attached to your arm
4	Connector	Connects the glove with the power pack
5	Cord	Transmits sensory data and force
6	Power pack	Controls grip force based on sensory data
7	Carbonhand App	Adjusts Carbonhand setting

The illustration below shows a close-up of the glove and connector.

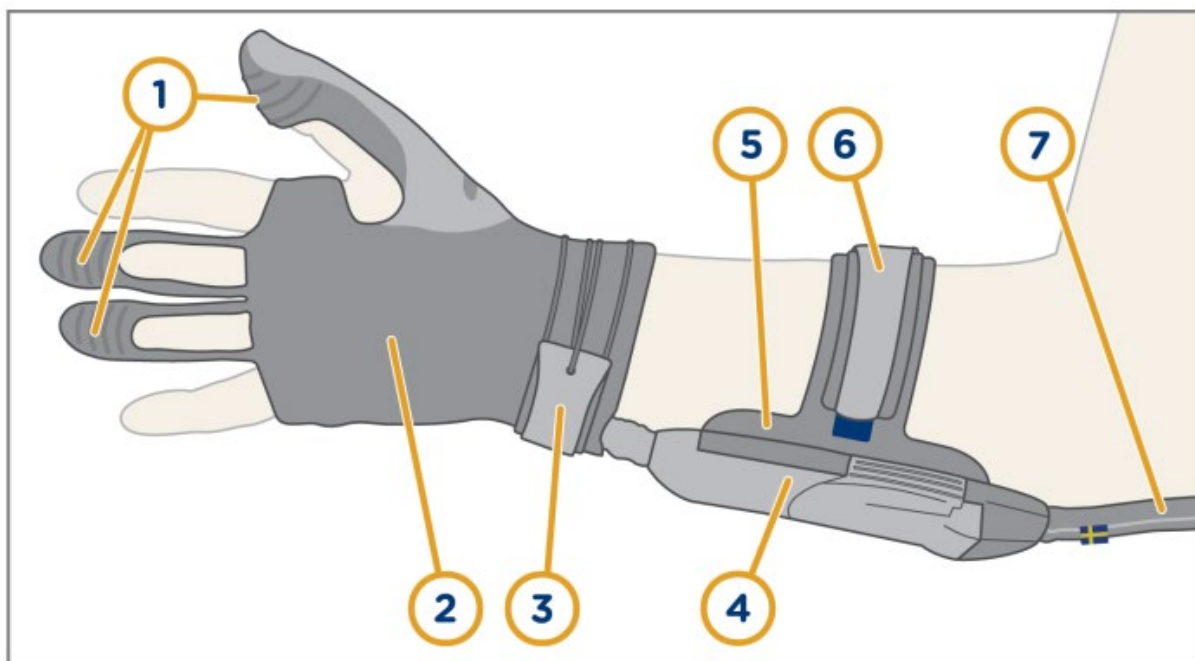


Figure 2. Carbonhand glove and connector

Item	Name	Function
1	Sensors	Provide data to control unit
2	Glove	Provides grip force
3	Wrist strap	Keeps the glove in position
4	Connector	Connects the glove with the power pack
5	Connector attachment	Keeps the connector attached to the lower arm strap
6	Lower arm strap	Keeps the connector attached to the lower arm
7	Cord	Transmits sensory data and force

Section 3 shows real-life photos of the products.

2.2 Function of the glove

The glove uses Bioservo's patented SEM™ (Soft Extra Muscle) technology. The glove mimics the hand's own anatomy using

- artificial tendons that transfers force to the finger in a similar way as the finger tendons;
- fingertip sensors that senses contact force between the fingers and the grasped object;
- electric motors that pulls the artificial tendons and acts like muscles;

- intelligent intention detection algorithms that ensures that the support is given when the user intends to grasp an object and releases the support when the user wants to release the grasp.

The glove is worn like a normal glove and covers the middle finger, ring finger and the thumb. The index finger is intentionally kept unsupported and uncovered as this finger often is used for fine manipulation and for picking up small objects and not for force grasps.

2.3 User group

The glove can be beneficial for anyone with impaired hand function. The reduced hand function can be on one hand the result of a medical diagnosis including, but not limited to, stroke, arm- and hand trauma, spinal cord injuries, MS and rheumatological arthritis and on the other hand caused by an accident leaving the hand function reduced. Furthermore, also age-related weakness such as sarcopenia can be the cause.

2.4 Use scenarios

The glove can be used in several scenarios, depending on the user's situation. Benefits to the user include

- Ability to get back to work or increase working hours. With improved hand function, people who previously have been incapable of working can be able to start working again. This gives a huge benefit to the society as the person becomes a tax payer instead of an allowance recipient. Even more valuable to the person it adds social contact as well as a sense of value, in contrast to alienation which often is associated with quitting jobs due to health or capacity issues. The same applies to persons who previously had to work only part-time due to lack of endurance in their hands, who now can increase their working hours.
- Improved quality of life for the elderly or others in need of personal assistance/home care for everyday tasks. With assistance from the glove, people currently in need of support can improve hand function which leads to increased independence. This is a big benefit for society as demands on assistance and home care is reduced. Increased independence also plays a big role in improved quality of life.
- Faster recovery from diseases or injuries. The glove can have a rehabilitating effect in two different ways.
 1. By direct therapeutic exercises, either performed at a clinic or at home. Some rehabilitation exercises can be difficult to perform for people with severe disorders in their hands. This creates big demands on rehabilitation therapists as they must be involved in most parts of the therapy. With support from the glove, these exercises can be performed with a higher degree of independence. This enables a higher intensity of therapy without increasing load and cost for the healthcare system as a whole. The users can perform these exercises at the clinic or at home.
 2. By turning everyday life into therapy. People suffering from reduced hand function have a big risk of inactivating that hand, which leads to further loss in hand function. By using Carbonhand, the user can increase security and confidence and hence activating the hand. This may lead to improved hand function as the glove only gives partial support and the user must use some force him/herself.

3 Pictures of the product



Figure 3. Close-up of the Carbonhand glove



Figure 4. Carbonhand user carrying a box



Figure 6. Carbonhand user walking with help from a walker and gets support holding on to the walker by Carbonhand



Figure 5. A user moving around with a wheelchair with help from Carbonhand



Figure 7. User holding on to a cup of tea with help from Carbonhand