D3.3.4
Glove Integrated Prototype
(fourth iteration)

ID and title	**D3.3.4 Glove Integrated Prototype (fourth iteration)**
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AMBIENT ASSISTED LIVING

JOINT PROGRAMME

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Document history

Version	Date	Status	Changes	Author(s)
V1.0	30/05/2016	First release		Alejandro Melendez, Hocoma
V1.1	31/05/2016	Reviewed		Martin Wahlstedt, Bioservo
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Status of deliverable

The final integration has been tested at Hocoma following internal quality guidelines and released on 20.05.16. Eight ironHand systems and four Hocoma Sensor sets were shipped to the project partners (2 systems _ 1 sensor set each) so that they are able to start with the studies planned in WP4.

Integrated prototype

The final integrated prototype (D3.3.4) consist of an iH Assistive System and an iH Therapeutic System (see Figure 1).

The iH Assistive System (D2.4.4) consists of:

(1) **Control unit***
(2) **5-finger Glove***

*Systems described in detail in D2.4.4

The iH Therapeutic System consist of:

(3) **Therapeutic platform -** The therapeutic platform refers to a computing system (e.g. PC or tablet) to which the iH Assistive System is connected. This allows the user to train with motivating game-like exercises and visualize his progress through automated reports.

(4) **Therapeutic software (D3. 2) –** Additional therapeutic functionality of the iH System is embedded in a therapeutic software. Software development complies with IEC62304:2006 and IEC 60601-1:2005 standards. This software include the following functionalities: assessments, connectivity, database, exercises, software architecture, safety mechanisms and user interface.

(5) **Hocoma sensors and passive arm support (optional) –** Hocoma sensors are Inertial Motion Units (IMUs) that, together with an optional arm support, allow the iH system to incorporate arm exercises. The Hocoma sensors measure the orientation of the upperarm, forearm and trunk. These signals can be incorporated into the motivating game-like exercises to train arm motion. The sensors have integrated batteries and transmit their data via Bluetooth. These Hocoma sensors are the same ones used in the CE certified medial product Valedo®Motion. A medically-certified arm support (e.g. Armon - http://www.armonproducts.com/products/edero/, MAS http://www.hankamprehab.nl/saebo/mas/) can be used in combination with the system in case the user requires it.

FIGURE 1 – THE IRONHAND (IH) SYSTEM.

Integration with additional hardware

D3.3.4 allows the use of additional Inertial Motion Units (IMUs) to track arm motion. This feature allows existing therapeutic exercises developed for arm therapy (Armeo®Spring, https://www.hocoma.com/world/en/products/armeo/armeospring/) to be used in combination to the ironHand System. This addition brings significant value to the whole ironHand concept, as it enables the user to train combined hand and arm movements within the same software environment. **This feature is available to the end-user organizations to gather feedback about this new feature. However, this feature will not be tested during the planned user trials, as this require changes in the experimental protocol.**

Therapeutic Exercises

D3.3.4 incorporates many exercises and assessments as summarized in Table 1.

TABLE 1: SUMMARY OF AVAILABLE EXERCISES AND ASSESSMENTS ON THE RELEASED D3.3.4

Exercise / Assessments	Therapy Goal							Requires	
	Finger coordination	Hand strength	Increase arm ROM 1-D	Increase arm ROM 2-D/3-D	Arm movement coordination	Grasping function	Cognitive training	Bioservo glove	Hocoma sensors
ironHand exercises/ assessments (D3.2)									
Submarine	✓							✓	
Birds on Strings	✓							✓	
High Flyer (Hand)		✓						✓	
HandROM (Assessment of hand ROM)	NA	NA	NA	NA	NA	NA	NA	✓	
Additional exercises enabled by the Hocoma sensors (optional)									
Balloons				✓	✓				✓
Brick Breaker			✓						✓
Clean Up				✓	✓	✓		✓ (optional)	✓
Diving				✓	✓				✓
Fishing				✓	✓				✓
Goalkeeper			✓						✓
Helicopter Rescue			✓	✓	✓				✓
High Flyer (Elbow)			✓						✓
High Flyer (Shoulder)			✓						✓
Pirates					✓	✓		✓	✓
Plumber					✓		✓	✓ (optional)	✓
Rain Mug			✓						✓
Roll the Ball				✓	✓				✓
Save the Monsters					✓	✓		✓ (optional)	✓
Supermarket				✓	✓	✓	✓	✓ (optional)	✓
Treasure Island					✓				✓
A-ROM (Assessment of arm ROM)	NA	NA	NA	NA	NA	NA	NA		✓

A-MOVE (Assessment of arm workspace)	NA	NA	NA	NA	NA	NA	NA		✓
A-GOAL (Assessment of arm movement quality)	NA	NA	NA	NA	NA	NA	NA		✓

Limited supervision use

A new added feature released in D3.3.4 is the capability for users to operate the Therapeutic Software under a limited supervision (e.g. home use). Different from the previously released version, limited supervision in this regard means the patient would be training on an ironHand System by him/her-self, without assistance. When patients log in with a personal password, they are be presented with simple instructions on the computer screen on how to adjust the ironHand System. From there, the software pulls their last-used therapy plan (created by (e.g) a therapist during an introductory session)

Users training in this mode do not have access to other patients' information nor will they are able to edit their own information. Users see the setup screens instructing them on how to adjust the ironHand System and then they will start training.

Remote support (telehealth)

D3.3.4 allows end-user organizations to provide remote support to users during the user trials. This feature was enabled using commercially-available software for remote interaction. In this way, man power for software development were then directed towards the usability of the system at home and implementation of training regimes in a motivating game-like environments – aspects that are critical for a *minimum viable* product. : The usability of a "telehealth" scenario, in which end-user organizations provide service to the users remotely, will be tested throughout the user tests in WP4. This usability testing, will identify what specific service and infrastructure features will be required (prio 1) for a final product.