

HANdle

A Novel Tangible Device for Hand Therapy Exergames

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Motivation and Basic Idea

Tangible User Interfaces offer many physical and interaction qualities, especially in all cases where solid surfaces and graspable shapes provide conducive haptic feedback to better perform therapeutic exercises. Obviously, tangibles seem to be well suited for hand therapy, treating injuries and conditions of wrist and hand, after accidents, stroke, etc.

Contributions

- | | |
|------------------------|---|
| Tangible Device | We iteratively prototyped a fully-functional controller that senses multiple finger forces, its relative position in space and that provides visual and vibro-tactile feedback. |
| Therapy Game | We developed of a playful and motivational tangible-based Exergame for hand therapy that supports different exercises including spatial movement, grasp and coordination tasks. |

Handle Concept

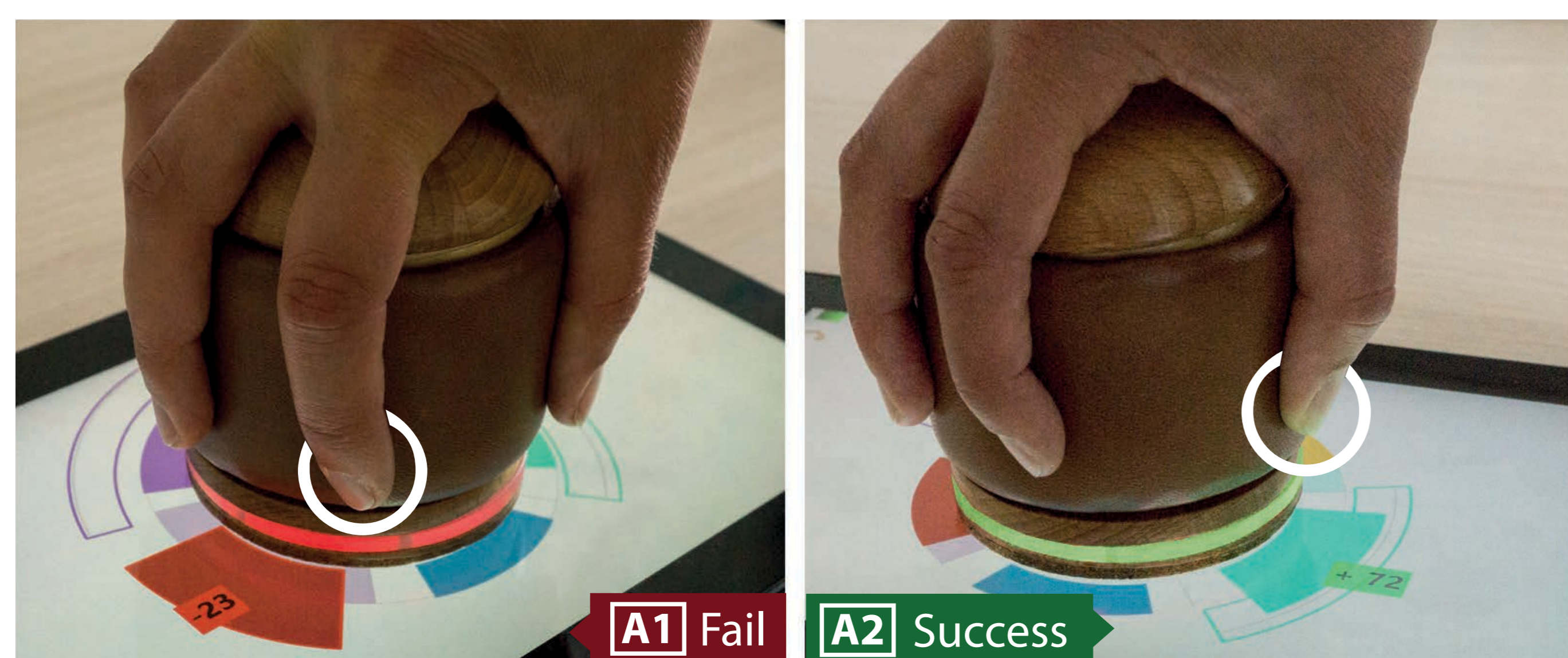
Our concept focuses on the individual and playful training of the wrist agility, finger strength, and its respective coordination to purposefully support hand movement rehabilitation and prevention therapies. HANdle is able to capture radial as well as orthogonal squeeze forces, senses its relative position in space and additionally provides visual and vibro-tactile feedback capabilities. In addition to the tangible controller, we propose the combination with interactive surfaces to create playful therapy games.

► HANdle App

Our companion application organizes all exercises that are created and assigned from the physiotherapist, stores the current progress and Exergame scores from the user and simultaneously provides visual feedback during the exercises.

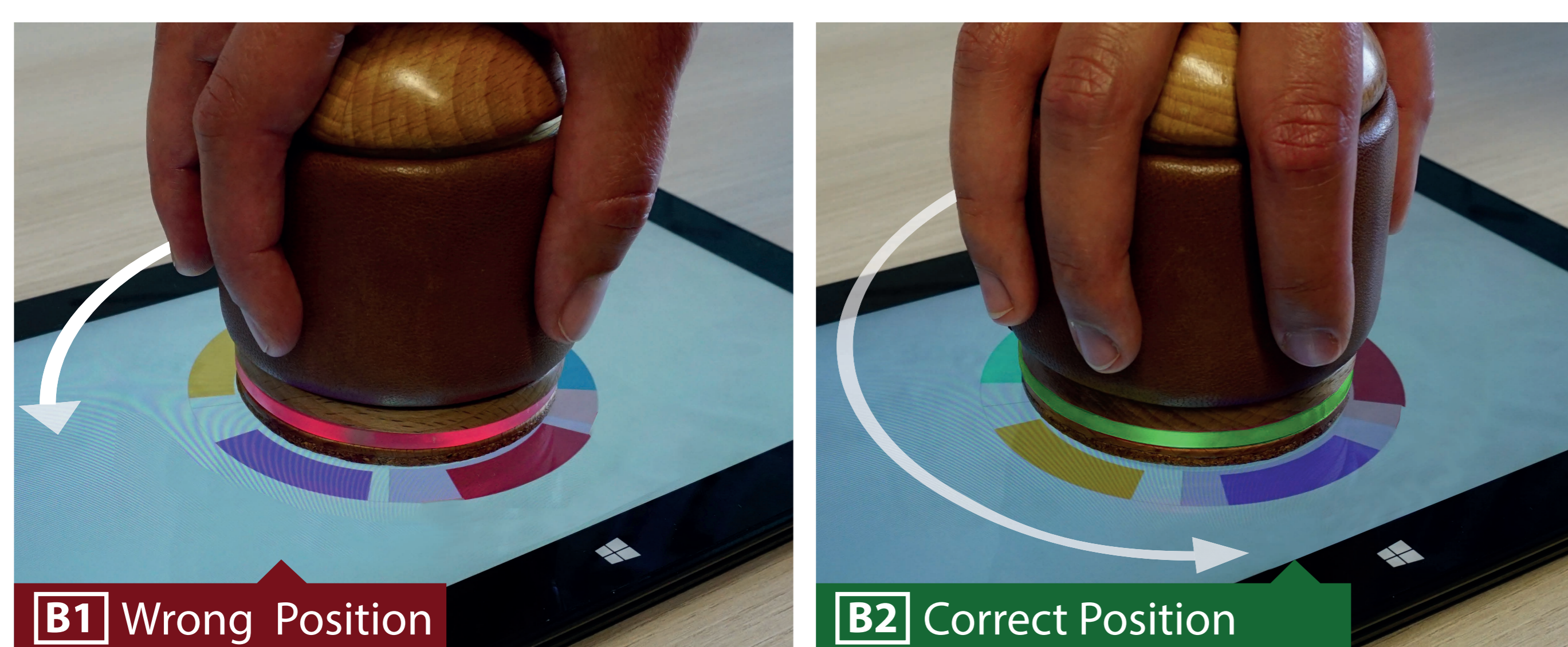
► Pressure Zones

We introduce grasp exercises in which the user has to squeeze certain regions of the pressure-sensitive tangible. When the user radially squeezes the tangible device, five color-coded circular segments increase proportionally to the applied pressure force at the respective position around the controller.



► Rotation Tasks

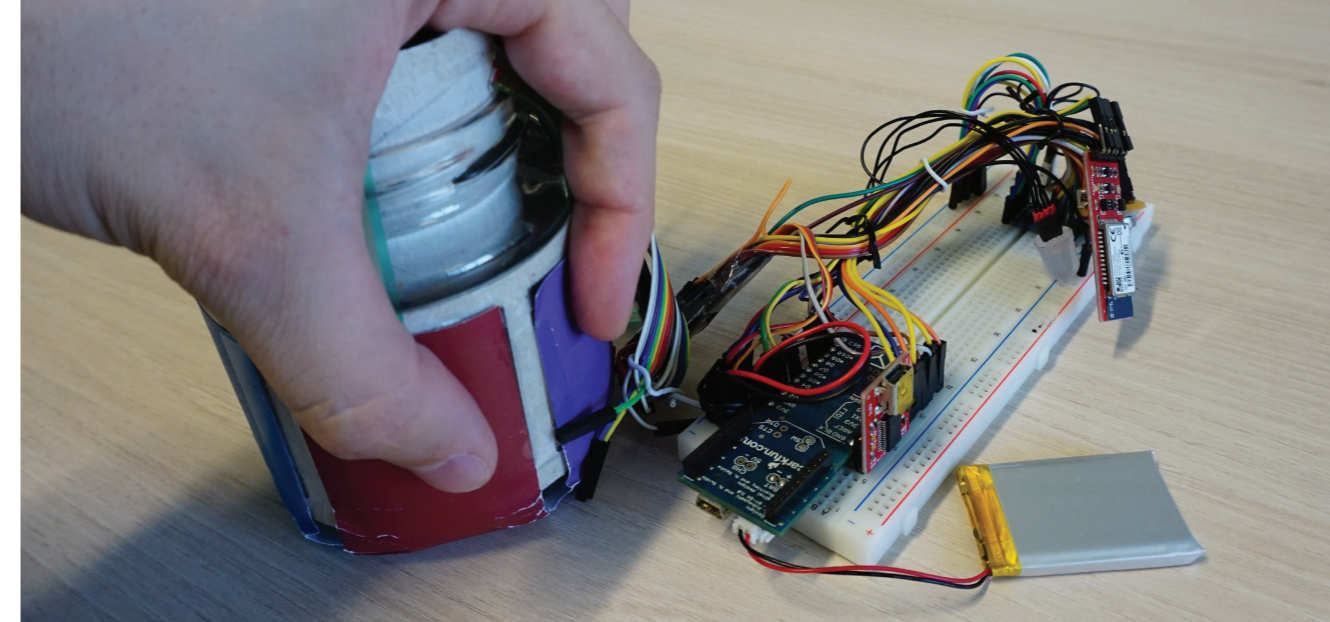
We propose training techniques that address hand agility by radial alignment tasks. The user has to rotate the controller until its attached circular segments (B1) match the target level segments (B2). These rotational exercises can be combined with the above-mentioned grasp force exercises.



Prototypes

Following an iterative design process, we first built a proof-of-concept prototype (see Figure C) that integrates all actuators and sensors in a fully-functional unit. Our second prototype (see Figure D), technically based on the first one, focuses on the design goals of haptic and mobile qualities.

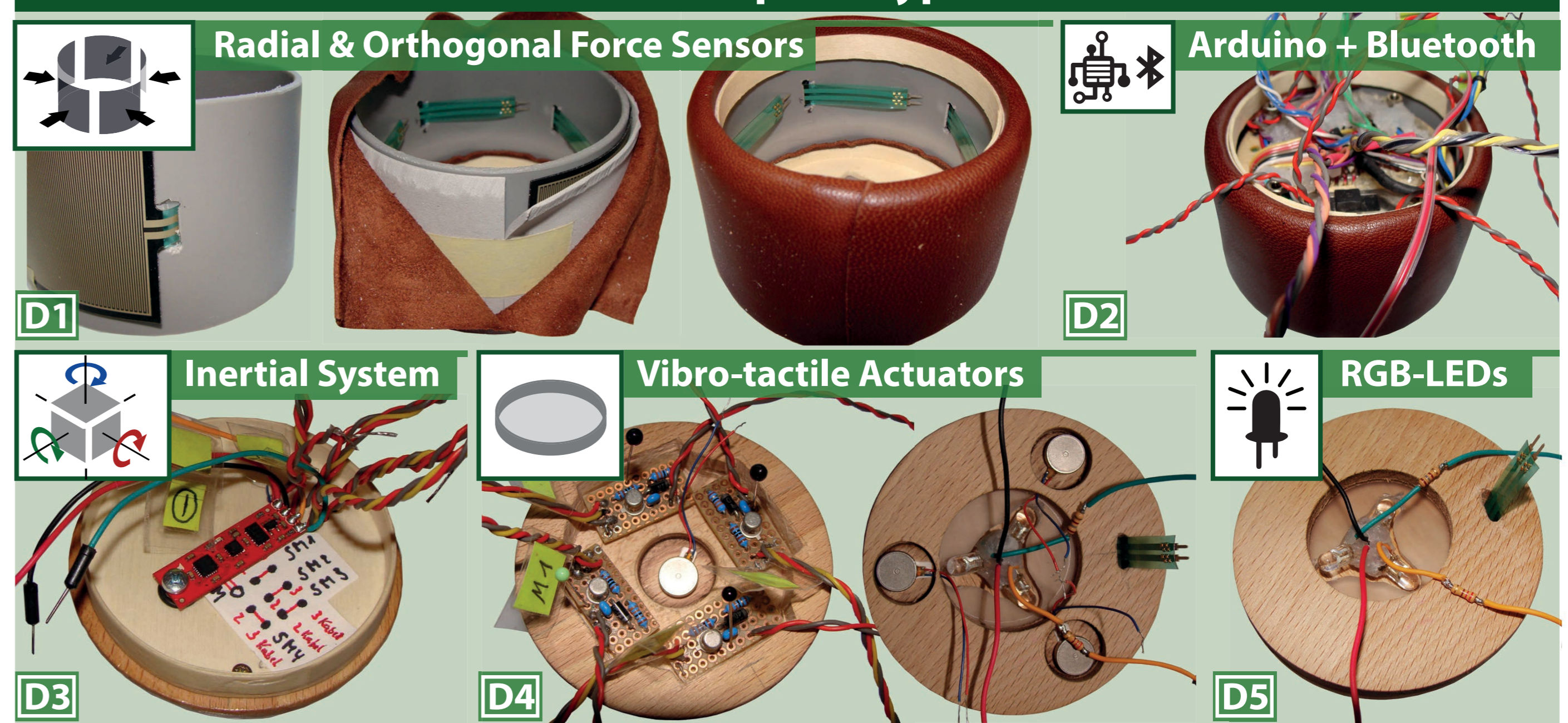
C Proof-of-concept prototype



D Second prototype



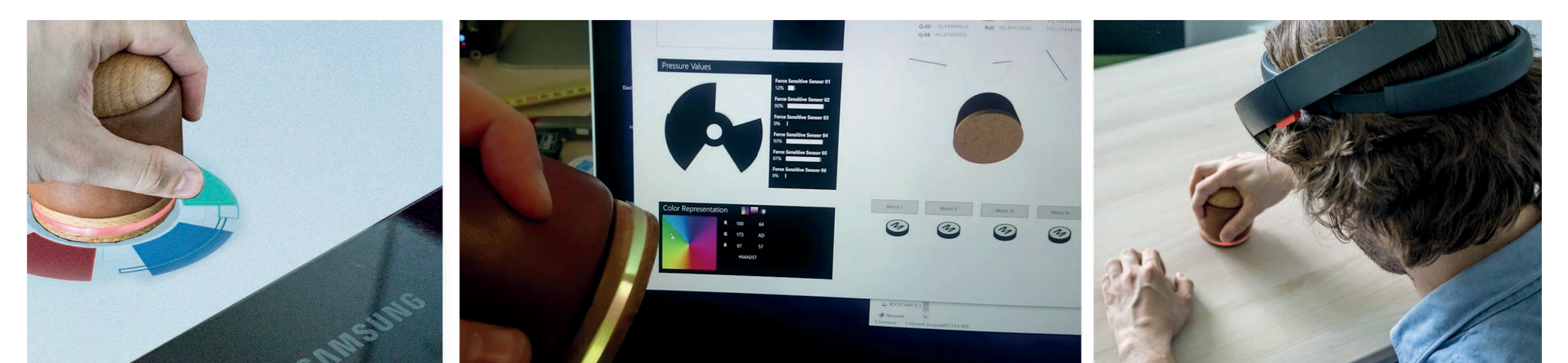
Fabrication details of the second prototype



Future Work

We already started to evaluate the qualitative usability and satisfaction aspects of our prototype with a small group of subjects. For future work, we plan to

- Integrate a set of therapy exercises together with physiotherapy experts into our HANdle system in order to run a first pilot study.
- Extend the existing exercises by 3D spatial movement tasks and built a task editor for physiotherapists.
- Combine the HANdle device with head-mounted AR-technologies such as the Microsoft HoloLens.



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