

Practical UCD in Hand and Arm Function Training for Children

Christina Mittag, Katharina Lorenz, and Regina Leiss

Abstract— This paper describes a user centered design (UCD) approach to analyze sensitive therapeutic contexts. We describe methods, challenges and prospects, using the example of the development of a technically supported therapy system for hand and arm function training for children with CP.

I. INTRODUCTION

Children with unilateral cerebral palsy (CP) suffer from limited ability to use one body side, which leads to dysfunction of one hand and learned non-use. They benefit from intensive training with the affected side to (re-)establish motor function. Other than adult stroke patients, children have never learned to use both hands to the full extent. Also, an insight in benefit and necessity of therapy exercises cannot be expected. Therefore, the SHArKi project strives for a support system based on playing and motivational aspects.

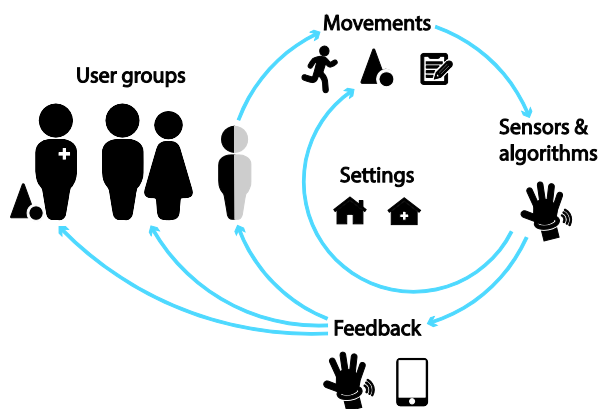


Figure 1. Overall context of the SHArKi support system

Wristbands with inertial measurement units (IMU) to detect movements form the basis of a playful motivation for more bimanual training and for feedback to children, parents and therapists (Fig. 1). Widening the therapy into children's daily life and individual adaptation will be additional benefits.

II. METHODS

With the standard DIN EN ISO 62366 [1], human-centered design was transferred to the field of medical engineering, aiming for design solutions that not only have a high usability, but also convince with a harmonic user experience.

Literature includes various methods and method collections (e.g. [2]) on the subject of user-centered design. Nevertheless,

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the selection, adaptation, combination or new development of methods for the respective application is decisive. For the selection of suitable methods, the research questions, the respective survey or workshop, the specific context as well as the user group should be considered. Applied to our context, we have to observe the boundary conditions as follows:

Although successful participation requires an *early* and structured approach of user involvement, ethical implications require that patients - especially vulnerable ones like children - are burdened as little as possible. Therefore, all available information and results must be evaluated before children are involved.

III. RESULTS

The project started with requirement analyses to sort a selection of methods in an order from the *view from outside* to increasingly sensitive topics. Thorough literature research on the clinical picture as well as on potential transferability of methods used for measurement and treatment of other patients formed the basis for further work. Work-shadowing and expert interviews provided an overview of the course of therapy and helped to concretize research questions. The instrument of the therapist workshop went beyond this: (1) therapy goals and movement exercises for children of different age groups were collected and prioritized through discussion in the group (2) therapy exercises were described and recorded with regard to the correct or paretic execution. Initial measurements with IMUs prepared the development of algorithms. On this basis, game ideas were developed for therapeutically effective and well measurable movements.

IV. DISCUSSION & CONCLUSION

Now, after all these methods have been exhausted, parents and children with their requirements, needs and ideas will be included for active co-decision and participation. Based on these first steps, mock-ups and prototypes of a support system will be developed and, in following phases of the project, tested in observational monitoring.

The described procedure in the SHArKi project will lead to deep interdisciplinary insight regarding the possibilities of gamification-based rehabilitation for children with CP from therapists', parents' and patients' points of view.

V. REFERENCES

- [1] IEC 62366-1:2015-02, Medical devices - Part 1: Application of usability engineering to medical devices. Berlin: Beuth Verlag
- [2] Hanington, B., & Martin, B. (2012). Universal methods of design: 100 ways to research complex problems, develop innovative ideas, and design effective solutions. Rockport Publishers.

Practical User Centered Design in Hand and Arm Function Training for Children with Unilateral Cerebral Palsy



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Project Goal

SHARKi project strives for a support system for children with cerebral palsy (CP) based on playing and motivational aspects. Wristbands with inertial measurement units (IMU) to detect movements form the basis of a playful motivation for more bimanual training and for feedback to children, parents and therapists. Widening the therapy into children's daily life and individual adaptation will be additional benefits. Designing a support system for patients - especially vulnerable ones like children - means working with the conflicting priorities of participatory design (user integration as early as possible) and ethical implications (stresses and strains for the patients as little as possible). Therefore, the order of research instruments is crucial and every setting with children has to be prepared with great care.



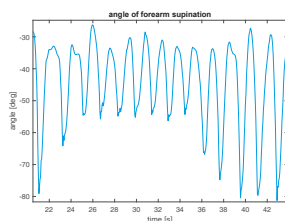
6. Next Steps

On the basis of initial IMU measures, first game ideas for therapeutically effective and well measurable movements are developed. Therapists, parents and children with their requirements, needs and ideas will be included for active co-decision and participation. Mock-ups and prototypes of a support system will be developed and tested in observational monitoring. The system will be improved in several loops of the iterative process.



4. Therapist Workshop

Therapy goals and movement exercises for children of different age groups were collected and prioritized through discussion. Therapy exercises were described and recorded with regard to the correct or paretic execution. Initial measurements with IMUs prepared the development of algorithms.



2. Work-Shadowing

Observation in the physiotherapy practice provided the scientists with a better understanding of the course of the therapy sessions. Patients of different ages with various levels of severity were observed.

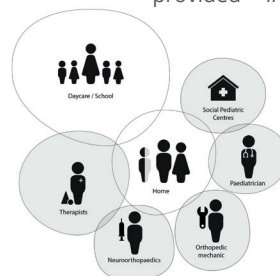
1. Literature Research

Investigating the clinical picture of CP as well as on potential transferability of methods used for measurement and treatment of stroke patients formed the basis of our work.

3. Expert Interviews

Physiotherapists and pediatricians provided information from their perspective. They explained the course of treatment, therapy measures, the target groups and their specific needs as well as the various relationships between the instances involved in the treatment network.

"Motivation is particularly difficult because there is not necessarily any prospect of improvement or noticeable success."



5. Parent Interview

During these interviews, parents describe different aspects of their children's life in a booklet on a timeline, e.g. developmental challenges, difficulties in everyday life, and course of treatment.

