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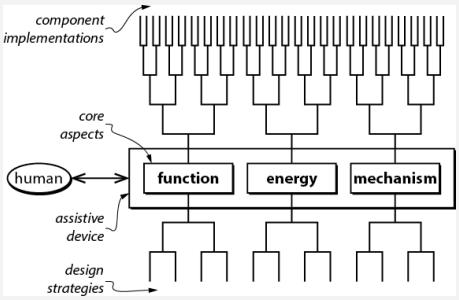
Background

Many stroke survivors or people with Duchenne Muscular Dystrophy (DMD) are limited in hand dexterity, often negatively affecting independency and social interaction. Assistive devices for the hand aim to recover or enhance hand functionality, ultimately improving the quality of life for such individuals. Many devices have already emerged and cover a large solution space, but they can also be linked through their fundamental design choices in function, energy and mechanism.

Aim

This study aims to provide for an overview of the complete solution space of hand assistive devices using an overall framework, by connecting the state-of-the-art on these devices through their fundamental design choices.



Method

During the literature search, only design and review papers of hand assistive devices were included in the analysis. The proposed framework consists of a structure of tree diagrams, allowing for backwards reasoning towards the fundamental design choices and forwards reasoning towards a multidisciplinary solution space. The basis is formed with three core aspects through which the device interacts with the human, introduced as ‘function’, ‘energy’ and ‘mechanism’. On one side of these core aspects, preliminary design strategies were defined which are independent of physical components and formed the roots of the tree diagram. On the other side, branches reach out towards unique component implementations.

Results

A total 77 different hand assistive devices were found. The majority focuses on the development of devices for a domestic setting, allowing physical therapy at home or assisting activities of daily living. The established framework reveals 97 unique component implementations, of which 44 were used only twice or less (e.g. task-monitoring control, hydraulic transmission). The most popular method for actuation is by far electric, mostly DC motors. The use of force control, transmission by (Bowden) cables and underactuated finger mechanisms are the most reoccurring component implementations.

Discussion & Conclusion

Results show that the development of a hand assistive device is becoming increasingly popular and the established framework illustrates the high complexity and diversity. The number of rarely-used compared to favoured component implementations indicates that the complete solution space is not yet fully explored. Here, the presented framework may help in the search for such novel solutions.

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