Using a Game Controller for Text Entry
to Address Abilities and Disabilities
Specific to Persons with Neuromuscular Diseases

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ABSTRACT
This paper proposes a poster about an alternative text entry method, based on a commercially available game controller as input device, as well as a demo of the accompanying software application. The system was originally intended for a particular gentleman with the neuromuscular disease Friedreich’s Ataxia (FA), who asked us to help him – by developing an optimal keyboard replacement for him – already several years ago. Our work focused on his impressions in an initial case study testing this newest attempt. Taking the tester’s comments into account, the outcome seems to be rather promising in meeting his needs, and it appears very probable that the system could be of help for anyone with a similar condition.

Categories and Subject Descriptors
H.5.2 [Information Interfaces and Presentation]: User Interfaces—Input devices and strategies; K.4.2 [Computers and Society]: Social Issues—Assistive technologies for persons with disabilities

General Terms
Human Factors

Keywords
Human-computer interaction, Friedreich’s Ataxia, nystagmus, dysarthria

1. INTRODUCTION
Neuromuscular diseases affect the pathways between nerves and muscles. They typically lead to movement problems, especially concerning fine motor control. Many patients are also subject to dysarthria (speech problems) and/or nystagmus (causing unconventional eye movements). The progressive hereditary condition Friedreich’s Ataxia (FA) – which shows all of these symptoms – is one out of many examples.

A certain FA patient, who is now 40 years old, approached us several years ago, asking for our help. He was (and still is) obliged to use a computer every day, involving a lot of text entry. Despite considerable motor problems, he is still able to use a standard keyboard, which he does due to the absence of a viable alternative – e.g., he cannot use speech recognition because of dysarthria, and his nystagmus makes eye tracking virtually unusable. Unfortunately, typing for him means a lot of effort (especially “traveling” from one key to the next without support, if the keys are far apart) and is very slow (nowadays just 2-3 wpm). Therefore, he is constantly looking for a suitable keyboard replacement.

With this intention, he was given the opportunity to participate in several evaluation studies involving keyboard replacements developed by us for persons with physical disabilities (e.g., [1, 2, 3]). However, as the approaches did not make full use of his abilities (e.g., he can employ both hands, when adequately supported), the results were less than optimal (see also [5]). In our newest attempt to help him, we wanted to tailor a tool specifically to his needs (hoping that the outcome would also be useful for others).

The game controller schematically illustrated in fig. 1 was chosen as input device: it was presumed that gripping the controller tightly with both hands should provide enough support (making it easy to hit the correct buttons) – the projected user agreed after a preliminary inspection of the device. Game controllers for text entry have been used already (e.g., [4]), but the reported proof-of-concept applications are mostly not intended to be used under real-world conditions, so we decided to design our own solution.

2. SOFTWARE DESIGN
The design of the developed software is characterized by the following three objectives:
1. The keys on a standard keyboard shall be replaced by the small number of buttons on the game controller. The basic idea how this is done is shown in fig. 2: the GUI (Graphical User Interface) presents an on-screen keyboard, where the user can pre-select one of eight rows with the D-pad; after pressing one of the six action buttons on the right, the corresponding character is “written”. Therefore, the dimensions of the on-screen keyboard is a direct consequence of the design of the used game controller. The depicted keyboard layout was chosen with the intention to make it easy for the user to remember it – it is, however, easily customizable. Additional characters as well as miscellaneous functionality are accessed using the shift and mode buttons and the triggers.

2. The application shall reduce the effort required from its user as much as possible.

To achieve this goal, the software has to implement common known approaches. For example, an own version of word prediction – in order to help the user save keystrokes – is included, or a “sticky shift”, so that the user is not required to press two buttons at once.

3. The solution must be practically usable.

This requirement refers to two considerations. First, the software must offer the functionality of a standard editor program, which not only means capital letters and punctuation, but also a cursor, text selection, copy & paste, undo/redo, find/replace, and so on. But most importantly, it must not be slower than the standard method (for the same user, of course) – if the user has to decide, either fast but with effort or effortless but slow, then something is wrong.

3. INITIAL CASE STUDY

A first version of the projected text entry system has been tested by the person it was intended for in an initial case study. The test involved an introduction into the software, five practical sessions on consecutive days, and a post-test interview asking the participant about his impressions.

In the practical sessions, the participant was asked to transcribe fragments of a given text as fast and as accurate as possible for at least two hours per day. The achieved entry rates were recorded, as well as some open comments about the individual sessions.

The numerical results revealed that the system provides no advantage over the participant’s usual method of entering text (the standard keyboard) in terms of entry rate (which ranged from .8 wpm on day 1 to slightly over 2 wpm at the end of the test). However, the participant likes the new method (and wants to use it again), because it makes text entry much easier and less exhausting for him, without requiring more time.

4. CONCLUSION

The application resulting from this work is promising in that it exactly meets the expectations: it decreases the physical effort (and increases the comfort) to enter text – e.g., by replacing the standard keyboard with a more compact device – and it is practically usable at the same time (which particularly means that entering text does not take longer than usually).

This is true at least for the FA patient the tool has originally been developed for, which could be confirmed in an initial case study. In addition to extending and refining the software, next steps include evaluating the system with more participants, in order to verify that the tool can indeed be of help for anyone with similar neuromuscular conditions.

The proposed poster will on the one hand present how exactly the software is organized (which will also be shown in the accompanying demo). On the other hand, the poster will give more details on the case study, including the entered text and the recorded results.

5. REFERENCES