Handle the Way: Enhancing Web Accessibility for People with Disability

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Abstract
The web has become the primary mechanism for information delivery. However, for people with an intellectual disability there can be significant barriers in accessing the web. This research aims to design a novel solution to help people with a disability, especially people who cannot type easily or correctly, to access the web independently. We propose to utilize Near Field Communication tokens to store and materialize website addresses into tangible handles for web access. Most importantly, we use tokens to store frequently used key words and serve as visual aids to enable query through combination of different search tokens. This solution has the potential to improve the quality of life yet is still relatively simple and affordable. Furthermore, together with other advanced technologies such as 3D printing for personalized tokens, it opens up the opportunities for co-design between people with disability and caregivers, customized services and collaborative support for diverse users via online volunteers.

Author Keywords
Web accessibility; inclusive design; user-oriented; tangible interaction; people with intellectual disability.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (HCI).

Related research

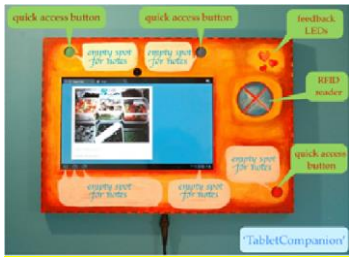

Figure 1: Prototype of a tablet companion with an RFID reader [4]

Figure 2: RFID cards and tags [4]

Introduction

People with an intellectual disability often experience difficulties with learning, understanding, adapting, socializing and self-caring. A survey conducted in 2012 found that around 2.9% Australians (668,100) have been diagnosed with an intellectual disability [1].

The web has become the primary mechanism for information delivery in many developed countries. However, for people with an intellectual disability, who may have difficulties dealing with written languages, understanding some internet concepts, and/or typing, there can be significant barriers in accessing the web. There is a pervasive lack of opportunities for people with intellectual disability to search for information on the web such as colorful images independently.

The advancement in modern technologies, such as touch screens, Near Field Communication (NFC), QR codes, and sensors, and the drop in their prices has made them available for an average household.

NFC facilitates identification of objects by enabled cards and devices. It allows two devices to exchange information when getting close to each other. NFC has been used for payments with credit cards, access control in offices, or ticketing. It has also been extensively used in game applications. Many smart phones are now equipped with NFC transceivers.

This research aims to design a novel solution to help people with an intellectual disability, especially people with difficulty in typing, to access the web independently. We propose to utilize NFC tokens to store website addresses (URLs) and materialize them into tangible handles to enable token-assisted web access. Most importantly, we use tokens to store frequently used key words and serve as visual aids to enable token-based query input through the combination of different search tokens. We can also have token-assisted login. This solution has the potential to improve the quality of life yet it is still relatively simple and affordable.

This research contributes to **non-traditional** avenues of web interaction design. In contrast to conventional web interaction techniques which are concerned more with satisfying complex information needs in mass markets and rely on the ability to manipulate written languages or typing, this project focuses on understanding the aspirations and capabilities of people with an intellectual disability and developing novel solutions to satisfy their special needs.

This paper will present the ideas, the system architecture, and discuss the opportunities of NFC technology from the web accessibility perspective. It focuses on using tangible interfaces to support users, who cannot type easily or correctly, access internet.

Related work

As our society is becoming more and more reliant on the web to share information it is important that people with an intellectual disability are not unnecessarily disadvantaged. This is especially apparent when we consider that many people with intellectual disabilities face challenges in traditional communication and social settings. Online communication can offer a rewarding method of interaction where the stigma suffered is lessened (Chadwick, Wesson et al. 2013).

A study showed that 25% of people with an intellectual disability used the internet (Carey et al, 2005).

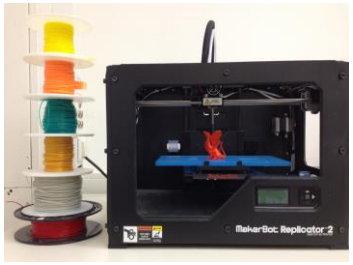

Figure 4: 3D Printer

Figure 5: 3D printed cheese block with embedded NFC token, demonstrating opportunities for personalized 3D objects as visual words.

Depending on the degree of intellectual disability, different methods of accessing the internet were required. Some were able to use the internet independently while others required help.

There is much interest in exploring novel technology-mediated communication that can empower people with special needs or other applications. Güldenpfennig and Fitzpatrick, as shown in Figure 1 and Figure 2, have developed a prototype for accessing a few frequently used websites such as 'www.wetter.at' using a tablet equipped with an RFID reader and RFID cards with tags [4]. The initial experiment shows that it can help older people who cannot type easily, access several websites. These cards link to websites such as Goolge.com but they do not contain individual search words so they are not used for submitting search queries. The *Tokens of Search* prototype in [5] also transforms web links into physical tokens, which are used for exploring the aesthetics of the home with web-connected physical objects. Similar to [4], the tokens here also represents a set of predefined web resources.

Method and Materials

We propose to use a set of technologies, including tangibles, mobile phones, tablets, desktop computers, and an online community to help people with an intellectual disability to access the web independently.

The system architecture is shown in Figure 3. The system involves three components: A computer with a display and internet connection, an NFC reader, and a set of NFC tokens containing frequently used websites or frequent keywords. The first two components can be a mobile phone with built-in NFC or a tablet or PC equipped with an NFC reader.

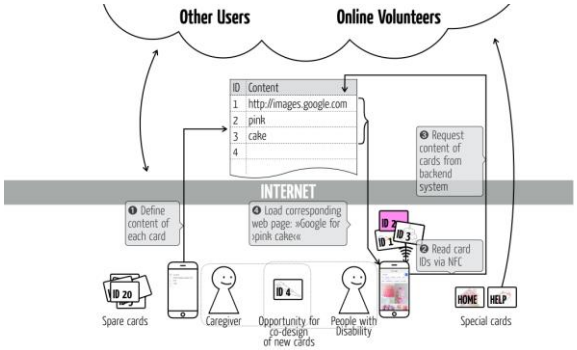

Figure 3: System architecture for token-based web access and search

Similar to [4] and [5], we use an NFC enabled cards or small 3D objects as a tangible handle to a web resource such as a website. Furthermore, we will take advantage of the combinatorial power of NFC tokens, which contains frequently used key words, to enable inputting search queries without typing at all. Figure 3 illustrates the process of searching for 'pink cake'.

We reserve several special tokens for special functions. For example, a special *Image* token will initiate a Google Image search and hence return pictures (e.g. of pink cakes). Accordingly, a *News* token will return news items about the search words. In addition, a special *Home* token can bring the user back to the homepage from the current location. This special token is essential as it acts as a safe net when users get lost during internet exploration. Another special token is the *Help* token that links people with disability to caregivers or online volunteers directly for getting help.

The NFC tokens used as an alternative input device can take the shape of a credit card because cards are easy to store and handle. They can also take any shape and color. Furthermore, they can be easily customized by taking advantage of modern 3D printers (Figure 4) which have become affordable to an average household. It only needs half an hour to print a cheese block shown in Figure 5, which can be used as a token for searching 'cheese'. 3D printing opens up the whole space for customized search interface design and enables co-design with people with disability.

This novel approach to web access has the following advantages: easy to use with powerful imagery (see the block of cheese), affordable, highly personalizable, and open for co-design between caregivers and people with disability. Potential concerns include: 1. the mapping between web concepts and the tangible features e.g. shapes and textures. 2. The number of tokens one person can have before the simplicity of the approach is reduced by the time and complexity of searching for specific tokens.

Conclusion

This paper has presented two key concepts for enhancing web accessibility for people with difficulty in typing. Firstly, use NFC equipped tokens, cards or small 3D objects, as physical handles to online resources e.g. 'http://www.google.com.au'. Secondly, use NFC tokens to store frequently used key words and serve as visual aids to enable query through combination of tokens without typing at all.

The research provides an opportunity to facilitate the linking of people with an intellectual disability to important information or entertainment available on the web. Yet, it is still simple and affordable with the recent developments on NFC and 3D printing technologies.

In the future we will prototype and evaluate the techniques with people with difficulty in typing and explore the potential use of this approach in both fixed and mobile scenarios. We will also research techniques to address the 'hard to understand' issue of information available on the internet.

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