FrontPanel: Tangible User Interface for Touch-Screens Dedicated to Elderly

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CHI'16 Extended Abstracts, May 7-12, San Jose, CA, USA.
ACM 978-1-4503-2474-8/14/04.
http://dx.doi.org/10.1145/2851581.2890266

Abstract
In this paper, we describe FrontPanel, a tangible user interface that enhances accessibility features in an iPad. More specifically, FrontPanel was designed for the senior population who has difficulty interacting with touch-screen tablets because of the lack of tangibility. FrontPanel is a result of one year help sessions with elderly who wished to replace their desktop/laptop computer with a touch-screen tablet that has the advantage of being light and mobile.

Author Keywords
iPad; Elderly; Tangible Interaction; TUI; Accessibility.

ACM Classification Keywords
H.5.2 [Information interfaces and presentation]: User Interfaces: Input Devices and Strategies, Prototyping, User-centered design.

Introduction
Since the launch of the first touch-screen mobile interface on the market in 2007, methods of interaction have been limited to semi-marginally actions [1] that are mainly modulated by visual feedback; i.e. the tactile interaction is restricted to touching a static surface – in this case a glass – with one or several fingers. Those limited actions are mainly visually guided without real tactile or haptic feedback. Brent Victor

refers to this interaction as the numbness of the fingers [2] and describes it as "pictures under glass" to depict the intangible nature of these interfaces. This lack of tangible feedback leads often to several errors and frustrations that are accentuated in older people [3]. Indeed, their perceptual and cognitive limitations are largely overlooked by the technology industry when creating touch-screen products which often limits their learning. In this paper, we suggest a plug and play tangible interface, FrontPanel, for an iPad tablet to make it more adaptable to seniors and to enhance the interactivity and the tangibility of touch-screen displays. Our aim is to learn about the particular obstacles that elders face when trying to pick up new technology. FrontPanel was the result of one year research observations during volunteering teaching sessions with seniors in a local public library.

Tangible User Interfaces that Interact Directly with the Screen

The concept of tangible user interfaces (TUI), where users interact physically with digital content, is not new and was pioneered by the work of Ishii, known as Tangible bits [4]. Since, several interfaces used this concept of turning digital information into a physically malleable and perceptible entity. When interacting with tablets, seniors often use a physical keyboard to avoid using the virtual one; mainly because their finger pressure is not strong enough [3]. Besides, several mistakes are made during typing because of the size of the virtual keys. Bettie (previously jive), a tangible interface, was developed to encourage elderly to connect with their family and friends [5]. The principal consists of placing tangible blocks on the touch-screen to activate the interaction [6]. Those blocks can be also laid out and combined to enhance physical interactions such as sliding or rotating [7]. They can also target a specific market such as Tuna Knobs to use a tablet as an auditory controller for DJs [8].

Although these tangible blocks extend the user's capabilities, they are less likely to function properly with elderly. Their main issue is that they hide a major part of the screen and are usually used for complex interactions that are of a less interest for seniors who use touch-screen for simple applications such as emails, social media, internet navigation, and pictures [3].

Finally a promising technology that could increase the interest of seniors towards touch-screen tablets is the Tpad that consists of an enhanced tablet that allows to feel virtual objects under the fingertip by modulating the friction while interacting with the touch-screen interface [9].

Plug and Play Tangible User Interfaces for Tablets

Rather than interacting directly with the screen few alternative solutions have suggested to connect a physical interface to the tablet; similarly to a mouse and a keyboard connect to a computer. For example, the bt.tn consists of a simple button that can perform several programmable actions on a computer, a tablet, or any digital interface [10]. In this interactivity paper, we suggest FrontPanel, an interface that was a result of one-year interaction with several seniors in our community that reach out to our volunteer program with a public local library to learn new technology including touch-screen interfaces (please see [3] for a full review).

FrontPanel

Similar to an old transistor radio, FrontPanel contains a total of six knobs, switches, and sliders. Instead of receiving HF waves, the interaction with FrontPanel results in performing tangible actions that modify or change the touch-screen display. In the following we describe, several implemented functions (see Figure 1) for an iPad. The purpose is not to replace a touch-screen interaction but to offer an alternative tangible solution that is less abstract and is handy when the touch-screen navigation proves difficult.

Toggle Switch: Home Button

The home button on the iPad is one of the few buttons available that allows outside-screen controls. Several seniors hold this button longer than expected and wait for an action to occur. In fact, the menu is displayed only when the button is released. We also noticed that some seniors forget that the home button is clickable and is not touch-sensitive, which often leads in a touch action rather than a click action. A toggle switch that consists of a lever that moves up and down allows an immediate and intuitive interaction to return to the menu.

Rocker Switch: Closing Applications

One of the hardest concept to get is applications running in the background. If they are not visible, they are technically not running, but still seniors want to close them to avoid being cognitively loaded. To close an application on an iOS tablet, the user has to double-click on the home button and swipe up to close an application. The issue resides in the double-click that requires the user to press the button two times quickly. For several seniors older than 70, quickly pressing a button is a tedious task and is often accompanied with stress because of repetitive failures. We opted for a rocker switch that has a spring-loaded rocker to take over this function. Similarly to an on/off action, the user can close application one by one.

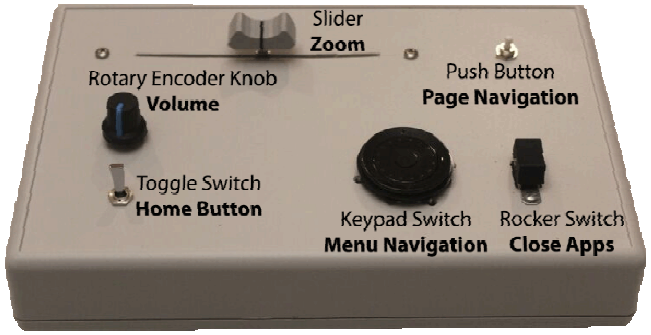

Figure 1: FrontPanel: a total of six controllers that allow to interact with several iPad functions (bold).

Push Button: Moving from one Page to Another and Select a Program

Depending on the number of installed applications, the user can end up with several pages. Some seniors forget that some of their applications are on different pages and require them to scroll from left to right to access to them. The push button serves this purpose. Not only, it is there to remind them the existence of other pages but allow them to navigate between pages and select a program.

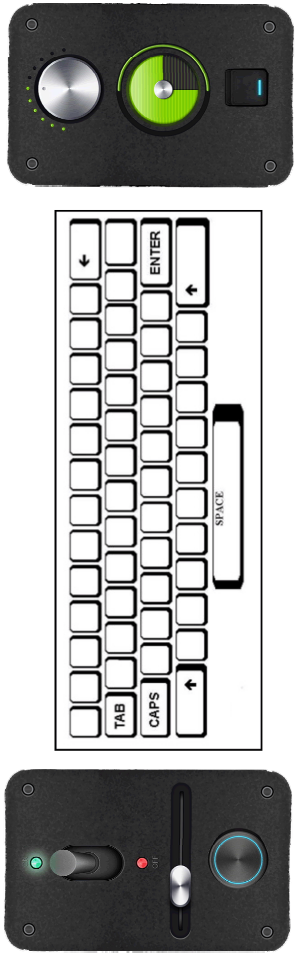

Figure 2: The final prototype of FrontPanel. The two blocks plug into the keyboard on both sides to share the load between hands and facilitate the interaction.

Keypad Switch: Menu Navigation
Another issue we noticed during our help sessions was related to menu navigation within an application. Not only the icons are not standardized from one application to another, but they can be anywhere on the screen (bottom/top left/right of the screen). After several training sessions, the elderly have difficulty remembering the location of basic functions such as send or print. For instance, to access the print function in the mail app, the user needs to go to the reply icon; while to access the same function in the camera app, the user need to click on the bottom left icon to access to it. Because the keypad switch allows navigation within a menu, the user can have a quick grasp of what is available.

Encoder Switch: Control Volume
The volume switch on the iPad is located on the top right corner. Although easily accessible, our purpose was to include a controller that is universally memorable as it is the case on any radio transistor or a front panel.

Slider: Zoom Function
To zoom in and out in an iPad, the user needs to use three fingers to activate the function and navigate through the screen. Using one finger is difficult enough for older users with low vision, the three finger interaction was an impossible task to perform during our help sessions. The slider allows to zoom in and out within an application and make the content accessible.

Future Work

FrontPanel is at its early stages of development and our next step is to test the interface during our help sessions with elderly. Figure 2 shows the final prototype that will be designed along with UX studies.

References

1. Mounia Ziat, Carmen Au, Amin Haji-Abolhassani, James J. Clark. 2012. Enhancing visuospatial map learning through action on cellphones. TAP 9(1): 5.
2. Brent Victor. http://worrydream.com/ABriefRantOnTheFutureOfInteractionDesign/
3. Mounia Ziat and Rachel Schmitt. 2016. Learning Tangible Interaction from Seniors. *ACM CHI 2016*.
4. Hiroshi Ishii and Brygg Ullmer. 1997. Tangible Bits: Towards Seamless Interfaces between People, Bits, and Atoms. *ACM CHI 1997*.
5. Bettie. http://www.bett.ie/
6. Sergi Jordà, Günter Geiger, Marcos Alonso, and Martin Kaltenbrunner. 2007. The reacTable: exploring the synergy between live music performance and tabletop tangible interfaces. *Conference on Tangible and Embedded Interaction* 2007. pp. 139-146.
7. Liwei Chan, Stefanie Mueller, Anne Roudaut and Patrick Baudisch. 2012. CapStones and ZebraWidgets: Sensing Stacks of Building Blocks, Dials and Sliders on Capacitive Touch Screens. In Proceedings of CHI 2012, pp. 2189-2192.
8. Tuna Knobs. https://tuna-dj-gear.myshopify.com/
9. Joe Mullenbach, Craig Shultz, Anne Marie Piper, Michael Peshkin, J. Edward Colgate, "Surface haptic interactions with a TPad tablet", Proceedings of the adjunct publication of the 26th annual ACM symposium on User interface software and technology - UIST '13 Adjunct, St. Andrews, Scotland, United Kingdom, ACM Press, 2013.
10. Bt.tn. http://bt.tn/.