OnScreenDualScribe with Point-and-Click Interface: A viable computer interaction alternative based on a virtual modified numerical keypad*

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ABSTRACT

This paper describes the experience of the first author with the *Point-and-Click Interface* of the *OnScreenDualScribe*, created by the last author. The new interface is an innovative extension to the previous interface which required the use of the *DualPad*. The main differences between the two interfaces are highlighted. The user took several writing tests with the *Point-and Click Interface* and compares her results with two of interfaces she uses the most for writing, *Dragon NaturallySpeaking* and *SofType*. Finally, the first author recommends several improvements to the interface which would make the software a better alternative for her.

CCS Concepts

•Human-centered computing → Keyboards; Accessibility design and evaluation methods; Accessibility technologies;

*An Extension of the *OnScreenDualScribe with DualPad*

†The experienced report primary user.

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Keywords

Virtual Keyboard; Assistive Technology; Text Entry

1. INTRODUCTION

The *OnSreenDualScribe* with the *Point-and-Click Interface* is a tool to aid users who are unable to use the standard keyboard or mouse. It replaces the large keyboard and mouse with a virtual on-screen keyboard that is aimed at reducing the number of keystrokes that are required to type a word by incorporating features such as word prediction. It is capable of empowering a person with limited mobility in their hands to type by only moving the mouse over the virtual keyboard.

The first author of this report has Spinal Muscular Atrophy. She requires assistance for all activities of daily living. Her movement is limited and she is only able to interact via a few fingers in one hand. She prefers using a track ball on a mouse for pointing as she requires assistance for from her caregiver to place her hand on the device and to reposition her hand when it slips. After about 1-2 hours of using a virtual keyboard, she fatigues and begins to feel "stiffness in her hands." This requires that she ask her caregiver to submerge her hand in water and massage her fingers for relief of the symptoms. Her two favorite interfaces for text entry are Dragon NaturallySpeaking, the current voice recognition gold standard for dictation and SofType for its word prediction capabilities. Word prediction tools are known to aid users when entering text on both desktop and mobile interfaces.

SofType™ by Origin Instruments is a Windows software that provides an alternative to a standard keyboard's functionality with a virtually accessible on–screen keyboard [16]. A user's mouse or preferred pointing device may be used to select a character on the computer screen that will generate

the corresponding keystroke on the active application. Additionally, a list of words are presented in the typing process with word prediction to reduce the number of keystrokes because the word can be selected from the prediction list and a space is automatically added at the end of the selected word. Different layouts of the keyboard can be changed based on the preferences and needs of the user. Other features include the AutoClick and Dragger with the common clicking functions of Double Click, Left Drag, Right Click and Right Drag for mouse usage. as an alternative to a standard keyboard's functionality with a virtually accessible on–screen keyboard [16]. A user's mouse or preferred pointing device may be used to select a character on the computer screen that will generate the corresponding keystroke on the active application. Additionally, a list of words are presented in the typing process with word prediction to reduce the number of keystrokes because the word can be selected from the prediction list and a space is automatically added at the end of the selected word. Different layouts of the keyboard can be changed based on the preferences and needs of the user. Other features include the AutoClick and Dragger with the common clicking functions of Double Click, Left Drag, Right Click and Right Drag for mouse usage.

Dragon NaturallySpeaking is a popular speech recognition system developed by Nuance [15]. A user creates a voice profile a completes the training process by pronouncing a list of words. The software learns overtime and transcribes spoken words accurately.

2. RELATED WORK

With improving computer technology, advanced methods to support individuals with disabilities in text entry evolve. Early alternatives rely on conventional keyboards and facilitate input by word prediction [9]. However, the analysis of spoken words and even video recordings in real-time is feasible nowadays. Hence, speech recognition [24, 7] and eye tracking [10, 1, 25, 19] are applied to control a personal computer. Regarding text entry, eye tracking serves as a mouse pointer allowing to operate an on-screen keyboard.

Contemporary, input devices with alternative hardware compared to the standard keyboard that do not require extensive computational power are available. Examples for such systems are EdgeWrite [23, 22] and Dasher [21]. While EdgeWrite uses two dimensional traces to represent individual characters, Dasher uses a pointing device for text entry. Various other systems rely on small keyboards: MessageEase [14] is an ambiguous keyboard with 12 keys similar to a phone keypad. Further approaches replace the standard keyboard by switch-activated scanning systems, e.g., Sibylle [20] and HandiGlyph [2]. Beyond those, OneKey and Qanti combine scanning with ambiguous keyboards [13].

Yet, these approaches might either demand too much or too little from a user with certain disabilities, e.g., Spinal Muscular Atrophy. The combination of small keypads and word prediction can reduce the typing effort and fatigue [18]: although some subjects might perform well with speech recognition, they might benefit from a physical entry device that is meeting their ergonomical needs. The user tester of this study can easily perform lateral movements on the screen using pointing devices but experiences distinct limitations in moving up and down. Thus she can make only limited use of approaches such as Dasher but can exploit systems that are more complex than single-switch input devices

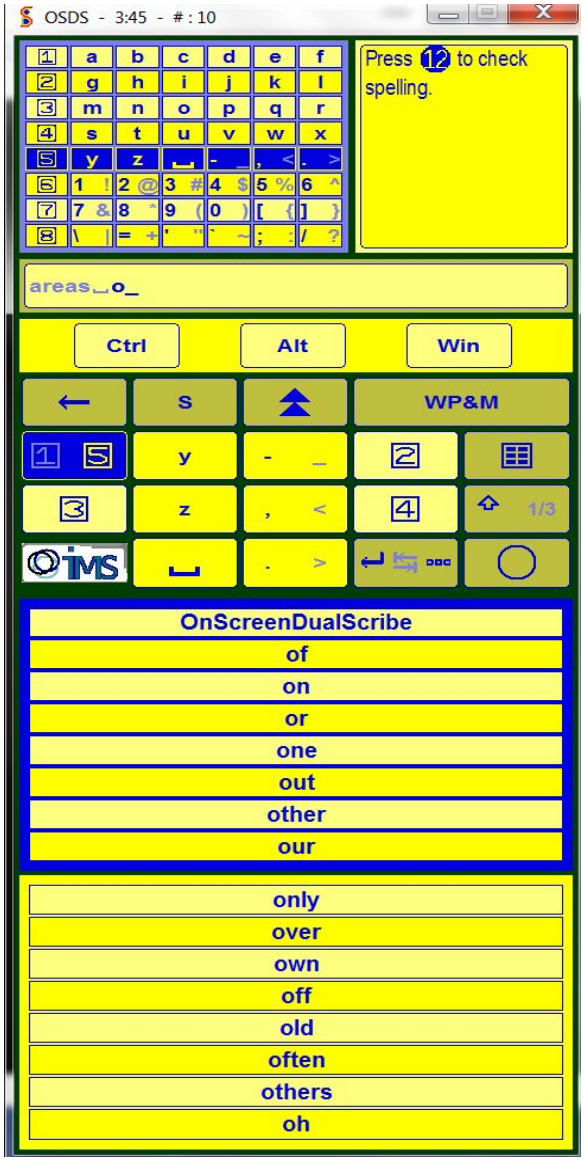

Figure 1: The OSDS interface.

such as MessageEase. Due to her limitations in motion capabilities and fingers that can be used during typing, special keyboards combined with word prediction seem appropriate to meet her needs [18]. According to [4], such keyboards can further be beneficial in pointing compared to standard keyboards [17], head tracking systems [6, 11, 8], or speech recognition [12].

3. THE POINT-AND-CLICK INTERFACE

Previously. the *OSDS* required the use of the *DualPad*, which in its latest form, is an off-the-shelf numeric keypad. It's smaller in size and the fewer keys made it possible for people with limited mobility in their hands to hold the keyboard and type with their two thumbs as did the last author of this paper. He was able to double his words per minute rate with the DualPad [5].

OnScreenDualScribe is a very powerful device with over 12 modes, but for the purpose of this report we will focus

solely on the default mode - the Dual Mode. This mode emulates the hardware in software; however, it does not require installing any software. You simply copy all the files to your machine and click on the executable [3]. The software captures all the interaction between the keyboard and the graphical user interface that has the focus. The Point-and-Click Interface was added for people who are not able to physically press down on the keys or hold the keypad in their hands as is the first author of this paper, but may have the similar challenges he had such as of not being able to use voice recognition. Video demos are online 1) https://www.youtube.com/watch?v=9N3bqeyyNjg and 2) https://www.youtube.com/watch?v=ZKku59T-gYo. Please visit url: http://www.felzer.de/data/osds_v309_build1003.zip to download the *OnSreenDualScribe* for free.

When participating in a study which examined the usability of OSDS, the first author was unable to exert sufficient pressure on the keypad buttons. The first author relies instead on the Wheel Mouse. As long as someone can place her hand on the mouse, she can use her index finger to move the mouse. Lateral motion is easier than vertical movement of the pointer for her using the Wheel Mouse. The Point-and-Click Interface is a viable option for her.

OSDS Dual Mode interface can be seen in Figure 1. The interface consists of four square parts. The top square basically presents the use with a new keyboard. The second square down contains the avatar which is where the user can interact with the interface. The third and fourth squares represent the powerful word prediction mechanism of the interface that contains over 100,000 words. The paper will briefly describe the features of the interface that were examined in the writing studies.

3.1 Clicking on Candidates

The Point-and-Click Interface allows for using the mouse button on the avatar to select potential candidate letters and to select words from the lower word prediction squares. So for example, if the user wanted to type the word *often* , the user would:

1.) roll mouse wheel over the [3] button and hover or press,
2.) roll over the [1][5] button and hover or press and finally
3.) select the word from the list of auto-completion options in the bottom dialog box, as seen in Figure 1.

3.2 Dwell Time Clicking

Taking into consideration users that might not be able to click on the interface using the mouse, the interface automatically issues a click if the user points at a clickable area for longer than a certain time period. That period of time is configurable and is called the *dwell time*.

For more information on the interface, reference the file in info directory of the software [3].

4. METHODS

The last author created a writing test suite of 5 random sentences that he asked the evaluator to enter using the OSDS and their favorite text input method. The entering of every sentence was timed and recorded automatically and statistics such as the number of edit operations, correct sentences and characters entered versus total characters was recorded. Thus, for every test in Table 1, five random sentences were typed to determine the Words Per Minute (WPM) and Errors. The test was taken over 7 days with complete rest breaks on Day 4 and Day 6.

5. RESULTS

On examining Figure Table 1 and Figure 2, it is evident that the first author's most efficient method for text input was Dragon NaturallySpeaking. However, it merits saying that in one week of using the interface, her words per minute doubled with the application. As the last author and creator of the interface recognized, the OSDS software requires period of adaption as most users are accustomed to using a qwerty keyboard.

The following are a list of comments from the first author on using the Point-and-Click interface of the OnScreenDualScribe software.

1. Volume is automatically adjusted when the application starts. In fact, even when the system is on mute on the volume control before opening the program, the application automatically turns the volume back on.

2. There is a sound effect after each keystroke that is distracting.

3. A tooltip on menu buttons could be helpful as clear instructions are provided only through the manuals. Since the keyboard is so novel, incorporating help into the interface could improve adaptation.

4. A space should be automatically added after each word completion.

5. When a word is typed with an alternative input (i.e. SofType keyboard) and then edited in OnScreenDualScribe, the word is not recognized with a multimodal interaction use.

6. Dragon NaturallySpeaking says "The correction hot key has been disabled because the same hot key is in use by another application. You may use the Options dialog to select a different hotkey" with a multimodal use.

7. Greek symbols and mathematical symbols can be inserted by OnScreenDualScribe.

8. The alphanumeric layout is difficult to adapt from the traditional qwerty layout. Users should be able to customize their preferred layout.

9. There are several bugs in the program because after maximizing the window, the application automatically closes down after pressing the apostrophe key twice.

10. Once the dwell feature is turned on, there is no way to turn it off unless the application is closed and reopened.

11. Once the application is maximized to the large size, there is no way to bring it back to the default size unless you reopen the application.

12. All of the application components are at the top right/left hand of the screen and that may be difficult for many users. It occupies a vertical screen space that is too narrow and difficult to navigate the mouse. Even if a word appeared into the prediction list, the first author

Table 1: Summary of Results for Each Method over 7 days

Day	Type	WPM	Errors	WPM Avg	Error Avg
5	Dragon	29.544	0.4		
5	Dragon	30.186	0.2	31.3	0.3
5	Dragon	34.23	0.2		
1	SofType	8.494	1.8		
3	SofType	9.516	2	9.4	1.5
5	SofType	10.3	0.8		
1	OSDS	2.69	2.2		
2	OSDS	2.282	7.2		
2	OSDS	2.864	0.8		
3	OSDS	2.832	1.6		
3	OSDS	3.376	0.2	2.0	3.7
5	OSDS	4.532	0.4		
5	OSDS	4.284	0.6		
7	OSDS	5.688	2		
7	OSDS	4.97	3		

kept typing the word out letter by letter to avoid moving a mouse to the location because of the difficulty.

13. The word predictions are helpful and the prefix of a word allows easy word changes. For example, to type the word "Anything", type 'A' then select "An" from word prediction list then "Anything" from word prediction list.
14. Font size cannot be changed.
15. Words with apostrophe do not show in prediction.
16. Only rows 1-5 are displayed even though there are 8 rows. Selecting rows 6-8 is little confusing because you have to remember how to alternate between rows 1-5.
17. After awhile the user becomes accustomed to remembering the letter of each row.
18. The test caused fatigue at times. Punctuation is the greatest challenge.
19. Different colors of the interface would be nice.
20. Selecting the rows is an efficient concept.

6. CONCLUSIONS

Whereas the interface of the virtual keyboard is very novel, it is complex and there is a steep learning curve. However, in one week of working with the interface, the first author was able to double her WPM with the *OSDS*. It is quite an achievement seeing as in the first week, the author can see the potential in interface and has suggested several improvements to the system.

In summary, the user's comments referring to the interface can be placed in six categories.

6.1 Customization

Research software may lack the extensive customization abilities of a more mature commercial tools which can cause barriers for new users, or test users. So there is little control over the volume and sound effects, the ability to customize the keyboard layout, or the ability to adjust the font size and the layout of the controls.

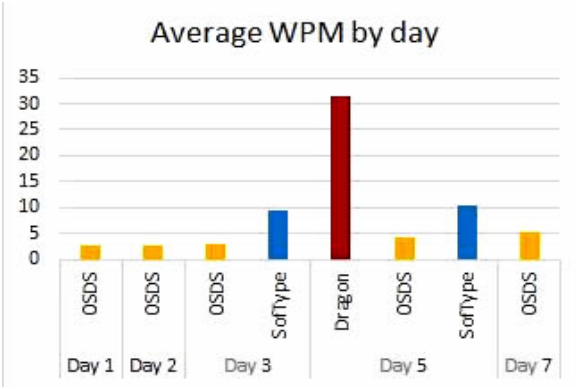

Figure 2: Comparison of OSDS Point-and-Click Beta Interface to SofType version 4.2 and Dragon NaturallySpeaking version 12.5

6.2 Usability

Most research software is not very customizable beyond the practical functionality such as the ability to minimize the window or to turn off dwell time. This first author has a preference for horizontal over vertical movement because of the fact that she can only use her index finger. She is not able to adapt the software to her needs. She also reported that she found the sound a little bothersome and would like to have the ability to turn the sound off.

6.3 Learning Curve

The interface was developed by an expert user who understood the complexity of the application. New users require time to learn the interface, although tutorial videos were provided. However, the more the experience report user began to use the interface, the more she was able to see the potential of the word prediction in the interface. For a new user, the interface may not be intuitive and there is a steep learning curve.

6.4 Multimodal Interaction

OSDS allows for the use with other methods like speech input and SofType. the benefit is that for some tasks such as dictation for a user who is able to speak using an alternate voice recognition method would be more efficient for using OSDS. However, for something like Latex or programming the OSDS, interface would be better. Having the ability to combine two or more techniques makes the interface more efficient and useful. However, there seem to be bugs with the multimodal interaction.

6.5 Efficient Row Selection

Efficient row selection combined with auto-completion allows for the pressing of as many or fewer characters than those in most words. So for example pressing the button [1][5] followed by [3] will populate the word completion with the all the words that begin with the letters in row [1] and are followed by the letters in row three. If the word is not listed but the combination is, the user can select the combination and pick another row, for example [4], where now the word completion is filled with all the words in its dictionary that begin with the first two letters and are followed by one of the letters in row [4].

6.6 Benefits

Finally, there are some benefits of OSDS over other systems such as the ability to type Greek Symbols and mathematical symbols. That makes it a much easier interface for programming. The efficient row selection in conjunction with the word prediction are novel and speed up the process of typing a word by a factor of 2 in most cases. Giving users the ability to have the best of both (many) worlds when the software can be combined with other assistive and allow the user to switch between the methods to use the most efficient or preferred method for the task.

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