**Interacting with Small Device Screens**

As the prevalence of small touchscreens on smart watches increase, there comes a need for better methods for interaction with technology. While the traditional method of interacting with screens is to tap and swipe as one would do with a smartphone or tablet, there are other interaction techniques that rely on spatial memory in an attempt to decrease the time needed to perform an action. The two I decided to compare are multitouch and sequential taps. Both have been used in current technology, such as Fitbits and Apple Watches, and here I will examine their pros and cons. This study is worth doing to compare two different common input methods, and I hope to have a better understanding of the challenges associated with designing wearable technology. The results are significant since the general trend of current technology is to be smaller and more portable, and therefore there is a necessity for more efficient input interactions.

**The Issue**

The issue with traditional interactions with touchscreens boils down to two factors. The small size of the screen leads to limited input and display space, and as a result means that not much can be shown on the display at once. This leads to many gestures needed to navigate the smart device. There are a few areas of work examined for the conceptual framework; interaction with small devices, command execution techniques, and command interfaces.

**Conceptual Framework**

Interaction with small devices and wearable technology often causes accidental inputs from inaccurate taps on the screen. As the size of the screen decreases, the chance of this occurring increases. A significant amount of time has been invested into finding techniques that do not need to interact with the display face. For example, Apple watches uses the watch crown as a sort of scroll wheel. Baudisch’s study in 1923 focused on interactions with the back of wearable devices [2]. Other proposed methods include using infrared sensors to extend available input surfaces, or using speech input [3]. Another method is the use of command gestures, but these interactions are time consuming to learn for users.

Command execution techniques all strive to reduce the time needed to invoke a command. There are different ways of doing so; enabling faster actions, increasing expressivity per action, reducing number of actions, and enabling parallelism. Multitouch interactions use parallelism by allowing more information to be simultaneously communicated to the device. Some examples include scrolling with two fingers or zooming on parts of the screen by pinching, or combining with menus to improve command execution.

Spatial memory techniques rely on user knowledge of item locations and their anticipation of where something will be located on the screen. The goal of spatially stable interfaces is to promote consistent actions that eventually increase efficiency by removing the need to visually locate something [4].

**Comparison**

Multitouch techniques make use of a spatially stable menu to help users learn the locations of items on the interface to execute commands. Once the gesture is learned, a two-step selection method can be reduced to a single step for faster execution. For example, instead of touching the interface with one finger, holding until the menu appears, and then selecting the item with a separate finger, an experienced user who is aware of the item locations can tap the menu and item simultaneously with two fingers [1]. This method has potential to have a higher performance ceiling and a greater chance of being adopted easily. In addition, the user interactions can be used on the watch along with traditional methods of navigation.

On the other hand, sequential taps are based on the idea that interactions with the interface can be accelerated through spatial memory. Instead of using two fingers for commands, a user taps twice. For example, tapping once opens the menu, and tapping a second time selects an item. As the user becomes more familiarized with the locations, the two separate inputs become somewhat similar to double clicking and speeds up input. This method is conceptually simpler than multitouch since there is only one selection method, and is therefore easier for users to learn. In addition, the errors that can occur can easily be undone; rather than committing all the way to a selection like with multitouch, users can change their selection midway or undo it easily since it remains a multi-step process [2].

The traditional method of swiping and tapping derived from larger touchscreens such as tablets often do not translate to smaller devices. Accidental inputs due to small icons and lengthy vertical lists that are time costly to scroll decrease the efficiency of devices that are supposed to be easily accessible. In comparison to the other two techniques, this method requires more visual attention.

**The Experiment**

The study I wish to conduct should evaluate the two techniques and how they compare to the traditional methods of swiping and tapping; how does selection performance differ across the three types of interface interaction? While multitouch and sequential taps do not afford themselves as much as traditional methods, I hypothesize that multitouch will perform the best in terms of speed since it inherently prevents against accidental inputs, followed by sequential taps, and then the traditional visual interface interaction.

First, a task is needed for participants to perform. Based on the research I have done, the basic format is to have an item-selection trial with menu systems that use different input techniques. An item should be displayed on the screen, and each trial the participant should select the corresponding item. An incorrect selection repeats the trial until the right selection is made, promoting learning.

This study should use a within-subjects design, since each participant will complete a condition for each of the three menu systems. In that regard, the independent variable is the type of menu system based off of input technique, and the dependent variable is user performance on tasks. The menu system order should remain constant for each menu system per trial, but differ across the three. If the experiment is split into different blocks for further randomization, the order of the items in the menu should be randomized every block.

Since multitouch and sequential tapping theoretically rely on a nonvisual aspect to increase speed, the experiment should account for that by possibly removing the second selection visual indicator. This should expose any spatial memories that had formed during the trial.

**Analysing the Results**

For this kind of experiment, a one-way ANOVA test can determine the differences among the means for the three techniques. One-way ANOVAs are ideal for three or more groups of data to understand the relationship between the independent and dependent variables. Pairwise T-tests can help further analysis of the data by comparing specific groups to each other. After the experiment is completed, a survey can be conducted to ask participants on what technique they preferred; multitouch, sequential tapping, or traditional swipes and taps. While particcipants may be impartial to what they are most familiar with, this should help shed insight on consumer preferences. This plays off of the idea of critical theory or understandings, interpretations, and everyday practices of the people that the technology is being designed for.

Since the goal is the decrease interaction time as much as possible without losing efficiency, the concept of microinteractions should be kept in mind. These are tiny bursts of interaction that take less than four seconds to initiate and complete, and there should allow users to continue paying attention to their surroundings [2]. When analysing results, special attention should be given to techniques that are close or lower than this time constraint.

**Conclusions**

Based off of information processing theory, where learning is done when interacttions occur, spatially stable menus can promote faster and more efficient command selection on smaller screens. Future research can be done in designing other spatial menus or how this applies to circular watches, and some other factors can also be tested. For example, how does overloading degrade selection performance, or how does grid size impact performance? However, these should be studied individually, and the experiment I outlined above should be completely isolated from such studies since these factors all contribute to efficiency of command selection, but in a different manner to each other. In addition, to level the playing field, subjects should be presented with a completely foreign interface to prevent participants that have experience with a certain device to skew the data. Special care should be given to understanding that although participants may be “random” members of a population, many volunteers often may have already had experience with smart watches to want to participate in such a study. An ethnographical approach can also be taken by placing subjects in a typical setting where one would sue a smart watch, such as walking down a street and observing their interaction with the device.

**Works Cited**

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