

# DualPad: Exploring Non-Dominant Hand Interaction on Dual-Screen Laptop Touchpads

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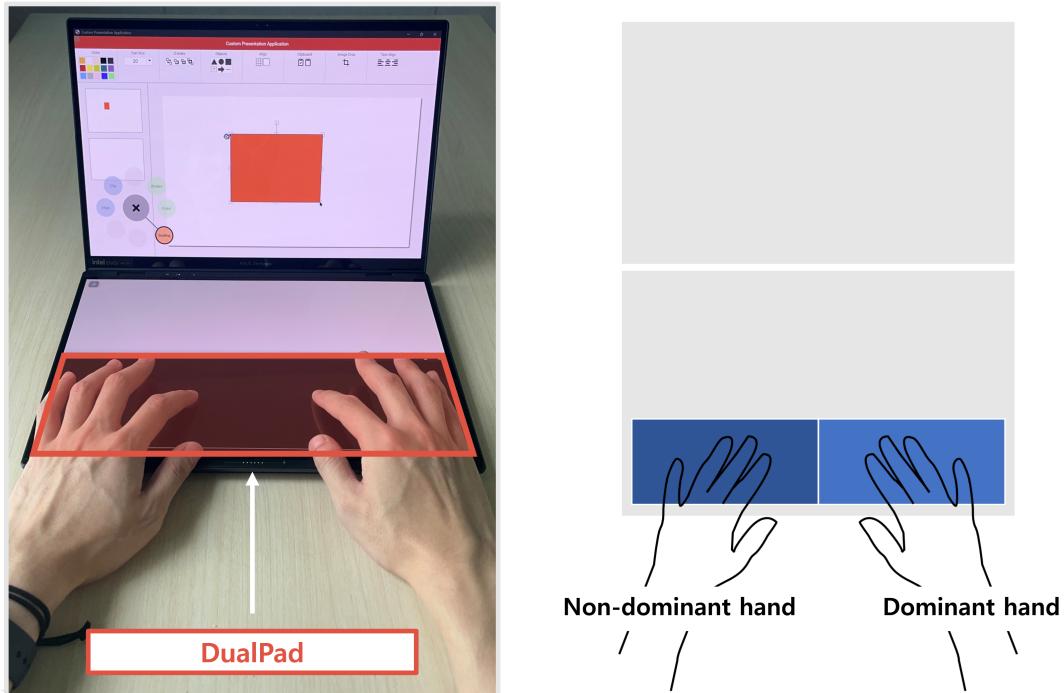


Figure 1: We propose DualPad, a long touchpad integrated into the lower touchscreen of a dual-touchscreen laptop. The non-dominant hand can be used to execute traditional functions of single-screen laptops as well as novel interactions.

## ABSTRACT

Dual-touchscreen laptops present opportunities for providing an expansive touchpad on the lower touchscreen. This expanded touchpad offers space for the engagement of both the dominant and non-dominant hands. In this context, it is necessary to redefine the role of the non-dominant hand. Therefore, we propose **DualPad** for dual-touchscreen laptops, which provides a long touchpad on the lower touchscreen. The non-dominant hand can utilize this DualPad to execute *Touch Shortcut / Modifier*, analogous to keyboard shortcuts and modifier keys on single-screen laptops. Moreover,

we propose *Dual Cursor* as an example of bimanual interaction. In the demonstration, participants are expected to utilize the custom presentation program to create the given slide using two distinct methods. First, they employ the default layout of the virtual keyboard and virtual touchpad provided on the dual-touchscreen laptop. Then, they utilize DualPad for comparison.

## CCS CONCEPTS

- Human-centered computing → Interaction techniques.

## KEYWORDS

dual-screen laptop, touchpad, non-dominant hand

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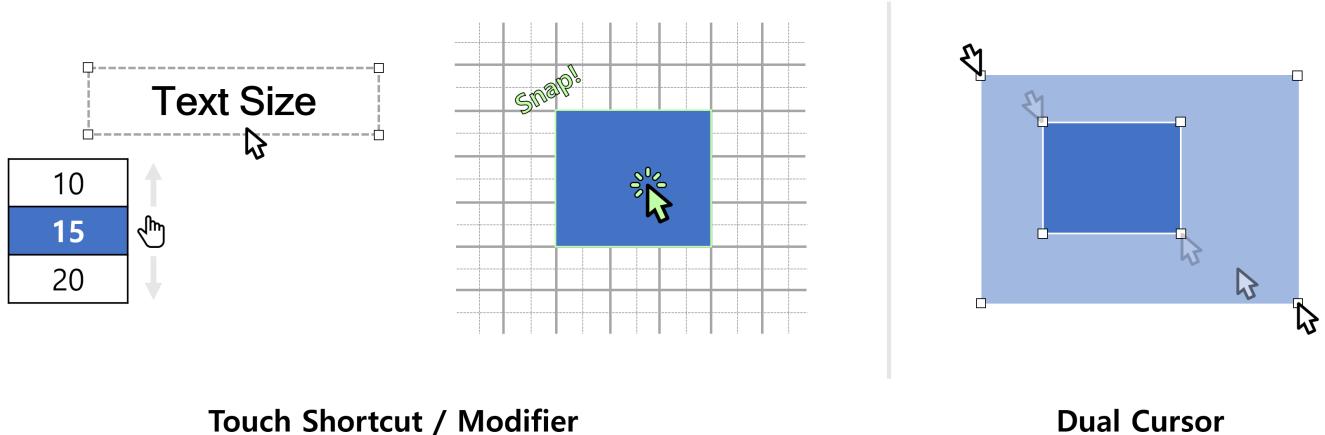
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**Figure 2: Classification of Interaction Design based on the Role of the Non-Dominant Hand in DualPad.**

## 1 INTRODUCTION

The introduction of LongPad[2], which transforms the area beneath a laptop keyboard into a proximity-sensing optical long touchpad, has opened avenues for innovative user interactions. In recent times, the advent of dual-touchscreen laptops has emerged as a commercial reality, enabling the implementation of extensive touchpads analogous to LongPad[2] on touchscreens. This expansive touchpad offers a more substantial input space and presents opportunities for the development of novel interaction designs.

In traditional single-screen laptops, the spatial limitations of the touchpad typically restrict its use to the dominant hand. Conversely, dual-screen laptops, with their provision for a broad touchpad on the secondary screen, create new possibilities for the engagement of the non-dominant hand. This paradigm shift necessitates a reevaluation of the non-dominant hand's function in laptop interactions. As the primary input domain of the non-dominant hand transitions from the keyboard to the touchpad, there is an opportunity to redefine the role of the non-dominant hand.

Users commonly employ one hand on the keyboard and the other on the touchpad in single-screen laptops. In this setup, the dominant hand is responsible for cursor manipulation on the touchpad, while the non-dominant hand is utilized for entering keyboard shortcuts or modifiers, thereby supporting the actions of the dominant hand. To leverage users' prior knowledge and habits, the non-dominant hand can be maintained in its supportive role while also introducing novel interactions previously unattainable.

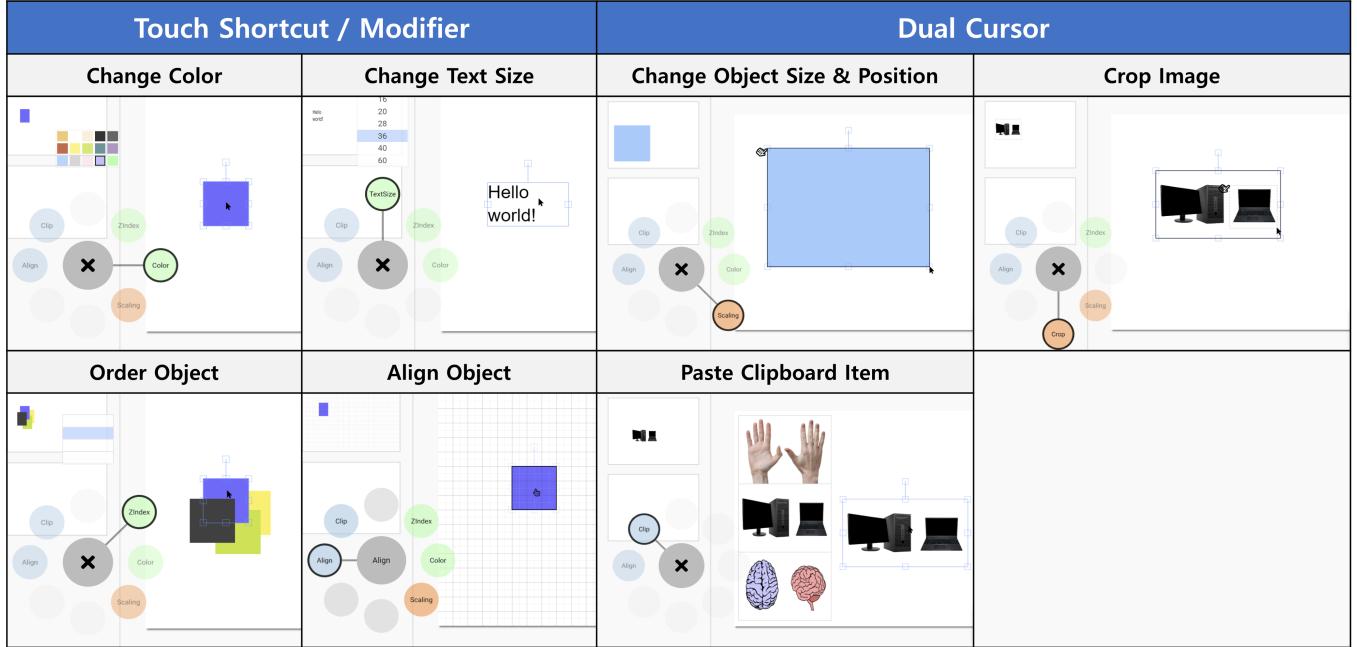
Therefore, we present **DualPad**, an extended touchpad located on the lower touchscreen of dual-touchscreen laptops. On the DualPad, we propose interactions that enhance the traditional role of the non-dominant hand through the use of *Touch Shortcut / Modifier*. Moreover, we explore an advanced role for the non-dominant hand through examples of bimanual interaction using *Dual Cursor*. These interactions illustrate the potential for expanded functionality and improved efficiency in dual-touchscreen laptops, offering a richer and more versatile user experience.

## 2 SYSTEM AND INTERACTION DESIGN

A dual-touchscreen laptop, featuring touchscreens on both the upper and lower sections, enables user interaction via a virtual input space displayed on the lower touchscreen when a separate physical input device is unavailable. This characteristic offers an expanded touchpad area compared to traditional laptops, providing ample space for utilizing the non-dominant hand. DualPad, a wide touchpad on dual-touchscreen laptops, is specifically designed to leverage the non-dominant hand. Therefore, the design of interactions on DualPad should consider the role of the non-dominant hand.

The role of the non-dominant hand in traditional single-screen laptops is to assist the dominant hand's cursor interaction by entering keyboard shortcuts or modifier keys. DualPad opens up a range of design possibilities to support these interactions by utilizing the non-dominant hand. In this demo, we propose using a marking menu[3, 4] as one example. The marking menu is displayed on the application in use (Fig. 3), and the non-dominant hand moves on DualPad to select menu options. Users are not required to verify key positions and the placement of the non-dominant hand, as is necessary with single-screen laptops. Instead it is similar to how the dominant hand manipulates the cursor on a touchpad. The non-dominant hand slides in the direction of the desired menu item on DualPad. In this configuration, users can access the marking menu in a target-agnostic manner because the start point of the marking menu does not need to be absolute.

Furthermore, DualPad enables the non-dominant hand to support interactions beyond its traditional role on laptops. One notable example is the potential for designing bimanual interactions within a laptop environment. Bimanual interaction enhances user usability and increases task speed[1, 5]. Although extensively researched on tablets[6–8], this concept has not been significantly explored in laptop environments. Unlike touchscreen devices such as tablets employ direct manipulation, laptops rely on indirect manipulation via a cursor. Therefore, one straightforward example of interaction design on DualPad is the creation of an additional cursor that operates alongside the existing one.



**Figure 3: Example Functions of Touch Shortcut / Modifier and Dual Cursor in a Custom Presentation Application.**

This demo illustrates two representative roles of the non-dominant hand on DualPad: maintaining the user's prior knowledge and exploring advanced functions for the non-dominant hand, as detailed below:

**Touch Shortcut / Modifier:** This interaction supports the non-dominant hand's traditional role of entering keyboard shortcuts and modifier keys. The non-dominant hand manipulates DualPad to select functions from a marking menu, and the function is then performed on the selected object.

**Dual Cursor:** This is an example of bimanual interaction enabled by using the non-dominant hand on the touchpad. In Dual Cursor, an additional cursor is created for the non-dominant hand. It operates the same as the cursor controlled by the dominant hand. Tasks that typically require two phases with one cursor can be integrated into a single phase by manipulating both cursors simultaneously.

### 3 PROTOTYPE

We implemented a prototype on a dual-touchscreen laptop based on the aforementioned interaction design. The apparatus utilized was an ASUS Zenbook DUO (UX8406), and we developed a custom presentation program as an example. This program enables users to manipulate text, shapes, and images, akin to functionalities found in conventional presentation software.

DualPad is a long touchpad divided into two sections: the left half for the non-dominant hand and the right half for the dominant hand (Fig. 1) (reversed for left-handed users). When a user selects an object (text, shape, or image) with their dominant hand, a marking menu that appears on the left side of the custom presentation program window explicitly suggests the available functions for

the selected object. The user can then slide their non-dominant hand on DualPad to choose one of the activated menu options.

In this demonstration, we implemented example functions within the custom presentation program. These functions are activated in accordance with the interaction design (Fig. 2) as follows:

#### Touch Shortcut / Modifier

**Change Color:** Select an object with the dominant hand. Use the non-dominant hand to select the *Color* menu from the marking menu. Move the non-dominant hand up, down, left, or right to change the color from the displayed color palette.

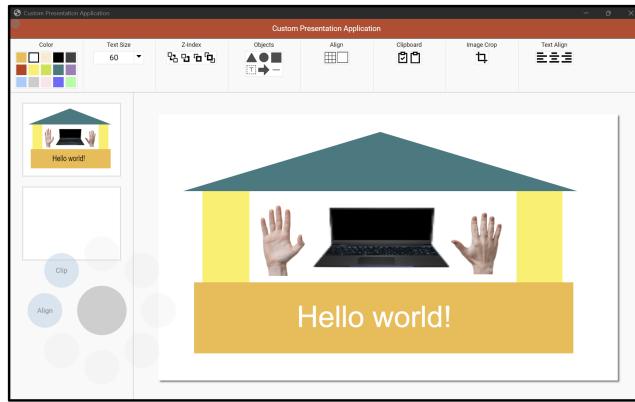
**Change Text Size:** Select text with the dominant hand. Use the non-dominant hand to select the *TextSize* menu from the marking menu. Move the non-dominant hand up or down to adjust the text size from the vertical menu.

**Order Object:** Select an object with the dominant hand. Use the non-dominant hand to select the *ZIndex* menu from the marking menu. Move the non-dominant hand up or down in the vertical menu to change the object's order. The initial z-index of the selected object is shown, and moving the non-dominant hand down sends the object backward, while moving it up sends it forward.

**Align Object:** Use the non-dominant hand to hold the *Align* menu from the marking menu as a modifier key. Move the object with the dominant hand's cursor, and it will automatically align to a virtual grid as long as the *Align* menu is selected.

#### Dual Cursor

**Change Object Size & Position:** Select an object with the dominant hand. Use the non-dominant hand to select the *Scaling* menu from the marking menu. Adjust the size and position of the object simultaneously by moving the dominant hand's



**Figure 4: Presentation Slide for *Home Sweet Home* Task.**

cursor and the non-dominant hand's cursor fixed at the top left and bottom right corners of the object on DualPad.

**Crop Image:** Select an image with the dominant hand. Use the non-dominant hand to select the *Crop* menu from the marking menu. Adjust the frame size and position to crop the selected image by simultaneously moving the two cursors on DualPad.

**Paste Clipboard Item:** Use the non-dominant hand to select the *Clip* menu from the marking menu. Then, the non-dominant hand's cursor is switched to the clipboard. Move it simultaneously with the dominant hand's cursor to choose and paste the desired item from the clipboard to the desired location.

## 4 DEMONSTRATION

In this demonstration, participants are expected to perform the *Home Sweet Home* task. The *Home Sweet Home* task entails replicating a provided slide, designed in the shape of a house (Fig. 4), using a custom presentation program.

Initially, participants are instructed to create the given slide using the pre-configured layout of the virtual keyboard and virtual touchpad, which are inherently integrated into the lower touchscreen of the ASUS Zenbook DUO (UX8406). This method resembles the traditional interaction approach on a single-screen laptop. Participants use their non-dominant hand to input keyboard shortcuts and modifier keys on the virtual keyboard while using their dominant hand to manipulate the cursor unimanually on the virtual touchpad.

The custom presentation program supports using the cursor to select the toolbar at the top or employing keyboard shortcuts. The keyboard shortcuts are implemented in the same way as those in Microsoft PowerPoint. The implemented functions of keyboard shortcuts are *Change Color*, *Change Text Size*, and *Change Order*. Alternatively, participants can directly select and adjust using the cursor on the toolbar located at the top. Also, participants can manipulate resize handles with the cursor to *Change Object Size & Position*.

Next, demo participants receive a brief explanation of how DualPad works. The features that participants utilize while creating the

given slide are as follows. This allows them to try out the *Touch Shortcut / Modifier* and *Dual Cursor* interactions of DualPad.

### Step1: Decorating the House

- (1) Use *Paste Clipboard Item* to select and position the images of computers and hands from the clipboard.
- (2) Use *Crop Image* to cut out only the laptop portion from the image of computers and to cut out the left and right hands from the image of hands image, respectively.
- (3) Use *Change Object Size & Position* to adjust the size and position of the cropped images of laptop and each hand.

### Step2: Building the House

- (1) Use *Change Object Size & Position* to specify the size and position of each shape.
- (2) Use *Change Color* to change the colors of the necessary shapes.

### Step3: Naming the House

- (1) Use *Change Text Size* to change the size of the selected text.
- (2) Use *Change Color* to change the color of the selected text.

Additionally, participants may use *Order Object* or *Align Object* as needed while arranging objects.

Through these steps, demo participants compare creating a presentation slide on a dual-touchscreen laptop using traditional laptop interaction method versus using DualPad. The demo expects to show that using DualPad can make interactions faster and more convenient.

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