MANUAL FOR USING ICT
AND
TEACHING ITS EFFECTIVE USE

Volume 2 Persons with upper limb motor dysfunction

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PREFACE

ICT stands for Information and Communication Technology. Although the progress of ICT has induced the issue of the digital divide, ICT can be extremely useful for life and independence support for persons with disabilities.

This manual is in four volumes. It summarizes elements of the knowledge on teaching and using ICT, which staff members of the National Rehabilitation Center for Persons with Disabilities have cultivated in training, research, and clinical practice for persons with disabilities.

Volume 2 draws from researcher at the Research Institute working on assistive products and technology for communication for persons with disabilities in their limbs to help disabled persons and supporters. It introduces techniques that can be used by persons who have upper limb disabilities to operate a computer mouse and keyboard and various techniques useful for operating alternative devices, smartphones, and tablets.

The URLs in this manual are current as of March 2021.

Currently, Japan is entering the world of 5G mobile communication systems, and ICT is expected to keep evolving. Hopefully, the teaching strategies in this manual should serve as a reference for the development and use of ICT.

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CONTENTS

Preface

Editor/Author

Chapter1.
Goal and Content of this Manual

This volume describes how to operate devices using alternative means when the upper limbs have motor dysfunction. This section introduces alternative input devices used when it is difficult to use standard devices like mouse and keyboards to operate personal computers, smartphones, and tablets.

Chapter 2.
Operating a Personal Computer

Operating a computer requires a mouse and keyboard as input devices. However, it may be challenging to perform these operations with motor dysfunction, which impedes the dexterity of fingers or limits the range of arm motion. In such a case, the accessibility features of the operating system or an easy-to-operate switch to perform mouse and keyboard operations on behalf of the user can be used. The click operation of the mouse and the key input operation of the keyboard are also switch operations. Nevertheless, it is necessary to consider a countermeasure when a person has difficulty clicking the mouse or pressing the keyboard.

Given below is an explanation of the methods and devices used when working with Windows 10. Users have various physical conditions. Thus, it is necessary to select devices considering their physical abilities and details of the accessibility features. For instance, a USB device will work even if multiple devices are connected. However, some devices may not start at the same time; thus, it is necessary to check whether all devices would start simultaneously.

1) Operating a mouse

Operating the mouse requires the user to move the mouse pointer and click or double-click the left or right button. Another device can be used if the user has difficulty using the mouse to move the pointer to an icon on the screen or has difficulty operating the buttons of the mouse.

    (1) Pointing the pointer

      ①   Consider using generic trackballs and slide pads

          Unlike moving the pointer by moving the mouse body, the trackball moves the mouse pointer by rolling the ball on the device. There is no need to move the whole trackball device. This technique is effective if the user has difficulty lifting the mouse or if the range of movement of the arm is limited; it is sufficient to move the ball on the device.

There are several commercially available products, such as those with large and small balls, for the user to try. The user can also try using a slide pad. Even when using a laptop computer, if the user has difficulty placing their hands on the main unit, they should try a separately connected slide pad.

② Using OS settings

The pointer can be moved using the numeric keypad. If it is difficult for the user to operate the mouse, they can move the pointer by pressing the keys.

Settings:

Start Menu > Settings > Control Panel > Ease of Access > Make the mouse easier to use > Check "Turn on mouse keys" (Figure 1).
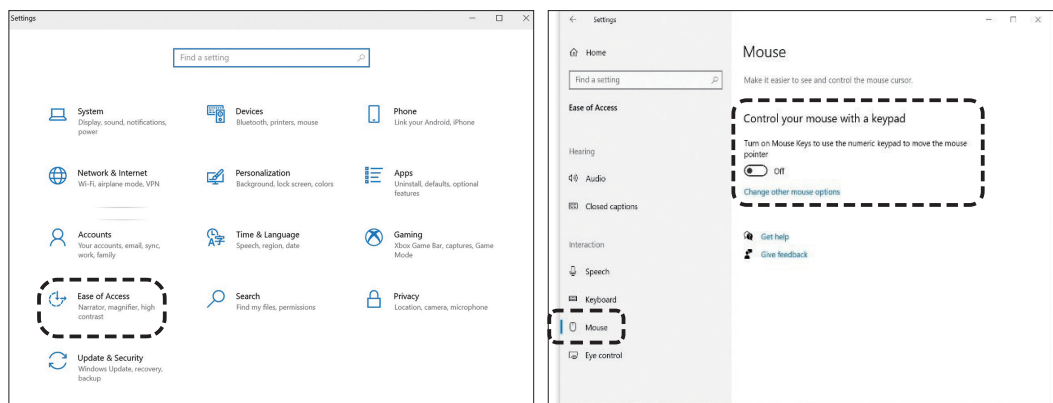

Figure 1. Control Panel　　　　　　　　　　Setting mouse functions

③ Moving the pointer using a switch (Figure 2)

a. If it is challenging for a user to move the pointer using a mouse because of difficulty in performing fine movements, the pointer can be moved by pressing switches that correspond to the up, down, left, and right movements of the pointer.

A joystick-type device is also available, which allows the pointer to move by tilting the joystick in the desired direction.

・Dekimouse project (Figure 2), Techno Tool "Rakuraku Mouse III"

Dekimouse S2.

https://dekimouse.org/wp/kiki/dekimouses2/ (Japanese)

Rakuraku Mouse III joystick type

https://www.at-mall.com/collections/pointing-devices/products/rakuraku-mouse-joystick (Japanese)

Rakuraku Mouse III joystick type

https://www.at-mall.com/collections/pointing-devices/products/rakuraku-mouse-button (Japanese)
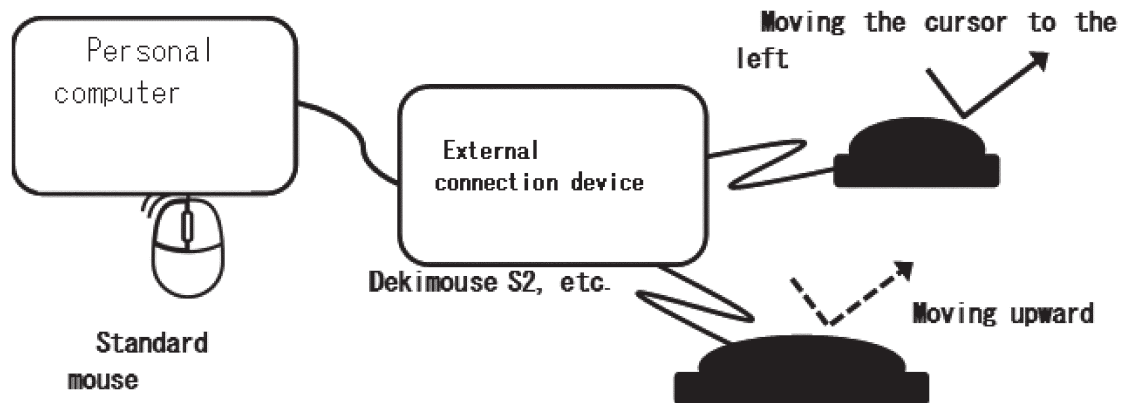
Dekimouse S2.

Figure 2. Moving the pointer using a switch
Even without using a standard mouse, the pointer can be
moved by operating an easy-to-press button switch.

b. If it is challenging to operate the four switches corresponding to up, down, left, and right, consider using an application software with two switches for horizontal and vertical movement, along with a function such that when the mouse pointer reaches the edge of the screen, it moves to the opposite side.

・Vector "Kabenashi," "WarpPointer"

Kabenashi

https://www.vector.co.jp/soft/winnt/util/se474464.html?_ga=2.200441960.77232 526.1627969076-34886302.1566292093 (Japanese)

WarpPointer

https://www.vector.co.jp/soft/mac/util/se137570.html?_ga=2.172811493.7723252 6.1627969076-34886302.1566292093 (Japanese)

c. If a few parts of the device can be switched, and only one switch can be operated, a "One-key mouse" can be used. Pressing the switch from the initial location moves the pointer to the right. Each time the switch is pressed, the pointer changes its direction to the right in the direction perpendicular to the direction of travel. When moving to the right, the direction changes downward. By repeating this, the mouse pointer can be moved to the desired location, and the pointer stops by long-pressing the switch. Pressing and holding while the pointer is stationary trigger the left click. Right-click

— 3 —

and drag operations are performed by assigning different switch operations. The user must only operate one switch to use the "One -key mouse." However, it is necessary to check the user's physical function because this mouse is operated by pressing the switch for a short or long period. Moreover, the number of switch operations increases significantly, given that the switch must be operated each time the direction of the pointer changes or a click operation is performed. It is necessary to judge whether it is possible to use this mouse by considering the susceptibility of the user to fatigue.

・TY Project "One-key Mouse"

http://www.ty-plan.com/03_fukushi/02_onekey/1keyusb00.htm (Japanese)

d. If an application software called "Operate Navi" is used, most of the computer operations can be performed with a single switch operation. A panel for mouse operation and a Japanese syllabary dial for character input are displayed on the screen. Thus, the user can select by auto-scan, move the mouse pointer, and input characters with a single switch operation. If multiple switches are available, manual scanning allows the user to operate at their own pace.

・Techno Tool "Operate Navi TT"

https://opnv.ttools.co.jp/ (Japanese)

④ Convert the movement of the device attached to the body (e.g., head or hands) to the movement of the pointer.

a. A small device is attached to a place where it is easy to move, such as the head or hand, and the movement of the body is linked to the movement of the pointer. This method is effective if the user has full control of their head.

・Techno Tool "Zono"

https://www.quha.com/products/quha-zono/

⑤ Operating the pointer using a smartphone

The user can install an application software on their smartphone and computer and launch it with the same Wi-Fi connection, allowing them to operate the pointer using a smartphone. The pointer on the computer moves when the user moves their finger on the smartphone screen, and tapping represents a left click. The operation is almost the same as the slide pad in ①, but no special equipment is required. This method requires a Wi-Fi connection, and functions differ per application software. Hence, it is necessary to confirm these factors.

・"Remote Mouse Pro"

https://itunes.apple.com/jp/app/remote-mouose-pro/id380450781?=en

(2) Clicking

① Use OS settings (Explorer settings)

Change the clicking method if the user has difficulty double-clicking the button within a short period. Normally, a single click will select a file or app, and a double click will open it. However, it can be changed such that pointing the pointer will select a file or app, and a single click will open it.

Settings:

Launch Windows Explorer, click the "View" tab, and click "Options" to show the "Folder Options." Typing "folder options" into the search bar in the Start Menu button will show "explorer options." Either way is fine. Select "Single-click to open an item" under "Click item as follows."

② Using OS settings (mouse properties)

The functions of the left and right buttons of the mouse can be changed. When operating the mouse with the left hand, the operation becomes easier if the button on the right side serves as the "left click."

Settings:

Open Start Menu > Settings > Control Panel > Devices > Mouse > Additional Mouse Settings > Mouse Properties. Check "switch primary and secondary buttons" under "Button configuration" in the "Buttons" tab.

③ Using OS settings (mouse properties)

By adjusting the double-click speed (maximum time interval for detecting a double-click), it is possible to perform a double-click operation that matches the user's physical characteristics. Adjust the speed accordingly if the user cannot perform a double-click quickly.

Settings:

Open Start Menu > Settings > Control Panel > Devices > Mouse > Additional Mouse Settings > Mouse Properties. Adjust the speed in the "Double-click speed" item on the "Buttons" tab.

④ Using OS settings (mouse properties)

If dragging is difficult to perform for users (moving the pointer while holding the left button), turn on "ClickLock" in the mouse properties. Instead of moving while holding down the left button (dragging), the user can press the left button for a long time, and the computer will recognize that the button has been pressed even after the button is no longer being pressed. Move the pointer and left-click once to cancel dragging.

Settings:

Open Start Menu > Settings > Control Panel > Devices > Mouse > Additional Mouse Settings > Mouse Properties. Check "Turn on click lock" on the "Buttons" tab to perform drag operations without holding down the mouse button (Figures 2, 3, 4).
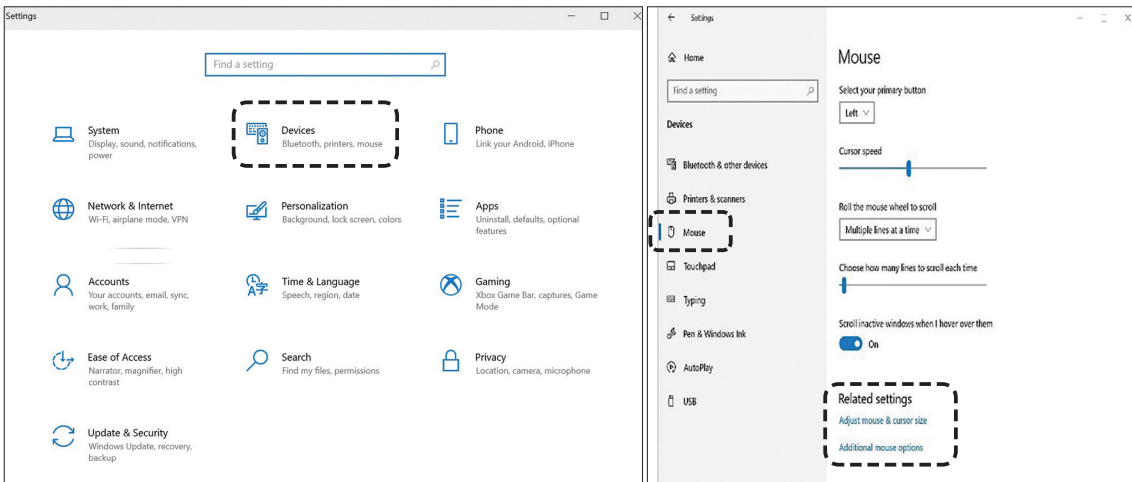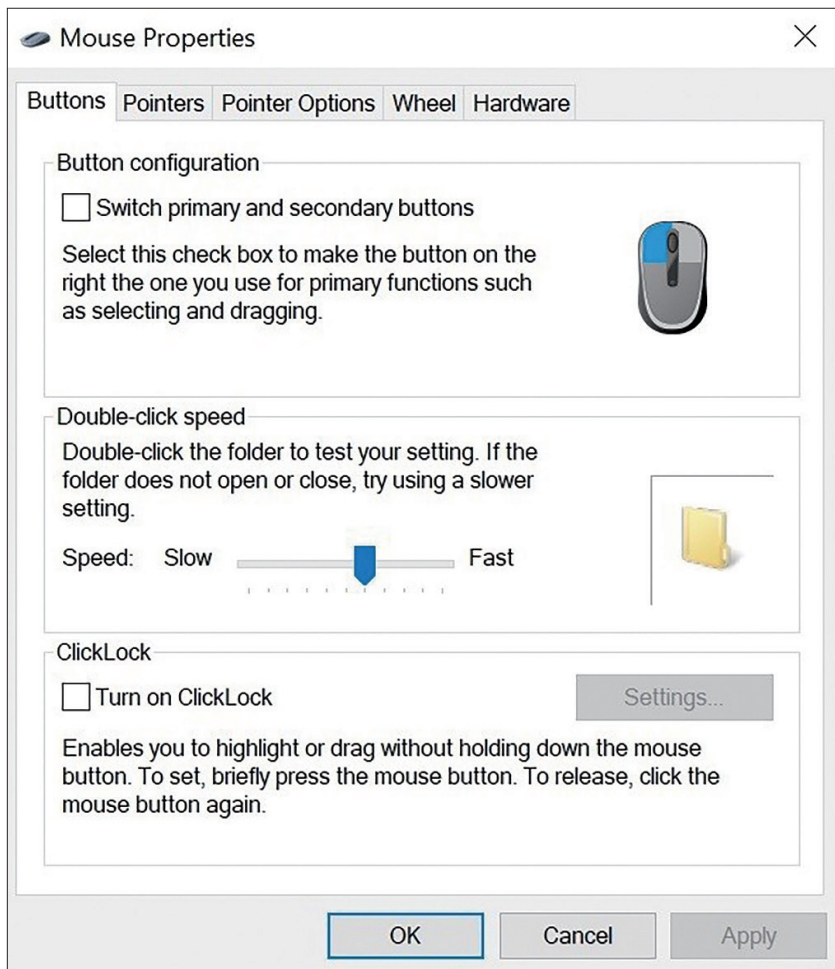
Figure 3. Mouse settings

Figure 4. Mouse properties

⑤   Clicking using a switch (Figure 5)

If it is challenging to click with the click button of a standard mouse, an easy-to-press switch can be used as a substitute for the click operation. Some devices function as usual when switches are connected to the connectors corresponding to the left- and right-click buttons. Others assign the functions of the connected switches to various operations of the mouse as a substitute for click operations. The latter requires software allocation settings.

A device that functions as usual by connecting a switch to the connector corresponding to the left- and right-click buttons

・Assistech "Click Jack" http://assistechlab,com/?pid=73140262 etc. (Japanese)

Assign the function of the connected switch to various operations of the mouse as a substitute for click operations

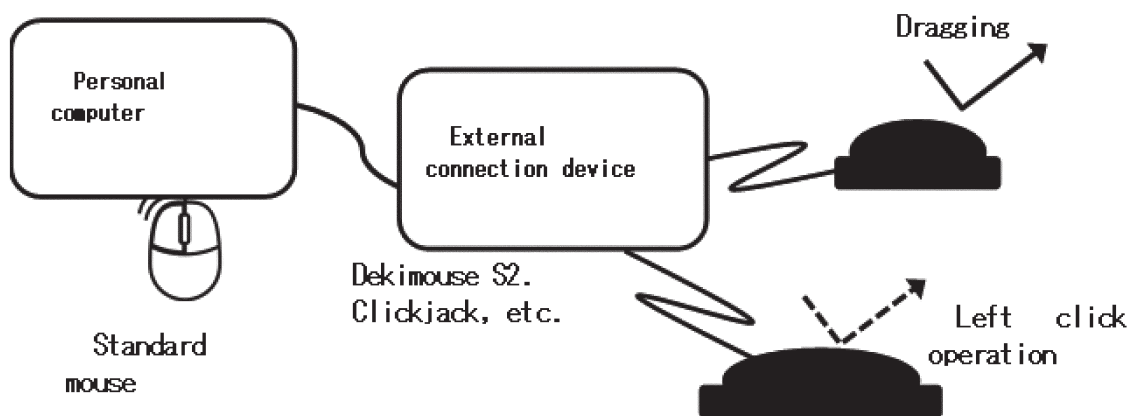・Dekimouse project "Dekimouse S2"

Clickjack

Figure 5. Image of mouse click operation using a switch
Even without the click button on a standard mouse,
a click operation can be performed by operating an
easy-to-press button switch.

⑥ Use an application software that automatically performs a click operation after a certain period after the mouse pointer has stopped moving

To use an application software that automatically performs a left click when the pointer is moved and stopped for a certain period without clicking the button or by switch operation

・Techno tool "Click Assist"

https://www.ttools.co.jp/product/hand/clickassist/index.html (Japanese)

⑦ Use an application software that allows the user to click and drag depending on how the user moves the mouse pointer just before it stops

"Shinobi click" executes a click or drag operation depending on how the mouse pointer is moved before it stops. This app is effective when the user can move the pointer but face challenges in executing a click operation.

・Hearty Ladder Supporter "Shinobi Click"

http://heartyladder.net/xoops/modules/d3downloads/index.php?cid=8

(Japanese)

Beyond the compatible products introduced, there are several relevant devices.

2) Operating a keyboard

Further, to operate the keyboard, except for operations that require simultaneous pressing and are intentionally pressed consecutively, it is necessary to press each key on the keyboard separately to press them exactly once and avoid pressing them simultaneously. There are also many keys. A laptop computer has around 90 keys that must be separately pressed. In some cases, the user has a limited range of motion, which prevents the fingers from moving over the entire keyboard. In other cases, the user's hands may tremble, potentially inducing the user to press the wrong key or unintentionally press the same key multiple times. The user may be required to press the Shift key simultaneously when entering capital letters or symbols or press the Ctrl key or Alt key simultaneously to execute special functions or enter special characters.

Thus, to avoid pressing adjacent keys, use a key guard to avoid pressing adjacent keys by mistake (Figure 6). Some companies make keyguards. Hence, it is a good idea to check if they can make a keyguard for the user's keyboard. If it is challenging for users to press the keys simultaneously, press the keys individually according to the keyboard properties setting (described later).

Figure 6. Keyguard

Some devices can substitute the Enter key and other key operations with a switch operation different from the keyboard. If the screen keyboard is used, it is possible to substitute the key input operation by moving the mouse pointer over the keyboard displayed on the screen and clicking it without using the keyboard itself.

(1) Using OS settings (keyboard properties)

Go to Start Menu > Settings > Control Panel > Ease of Access > Keyboard, and turn on "Sticky Keys," "Toggle Keys," and "Filter Keys." Each function will be useful for the user. The user can make even more detailed settings, such as key operations when activating each function.

① "Sticky Keys" should be set when the user has difficulty pressing multiple keys simultaneously (Figure 7).

With Sticky Keys enabled, the user can use the functions of the Shift, Ctrl, Alt, or Windows keys without pressing the keys simultaneously. Regarding Ctrl+Alt+Del, pressing the Ctrl, Alt, and Del keys in order is the same as pressing them simultaneously.
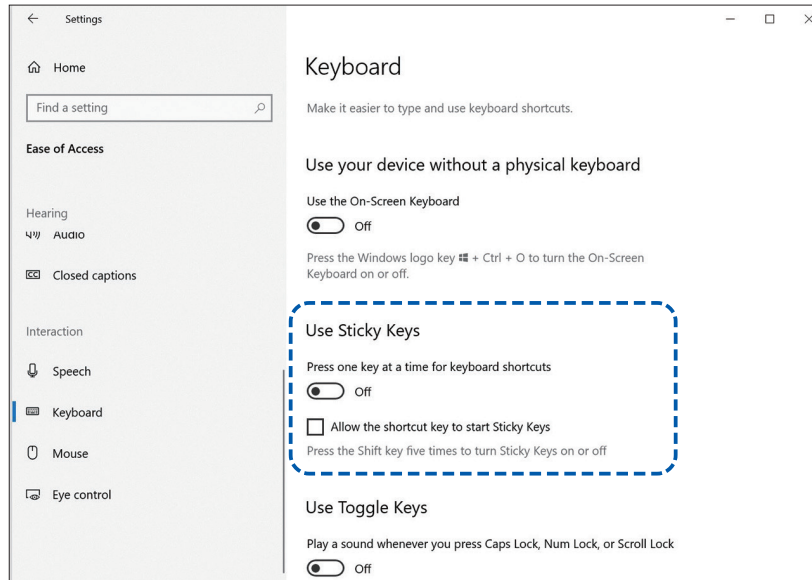

Figure 7. Sticky keys

② The "Filter Keys" function changes the spacing between keyboard inputs to ignore fast or repetitive keyboard operations (Figure 8).

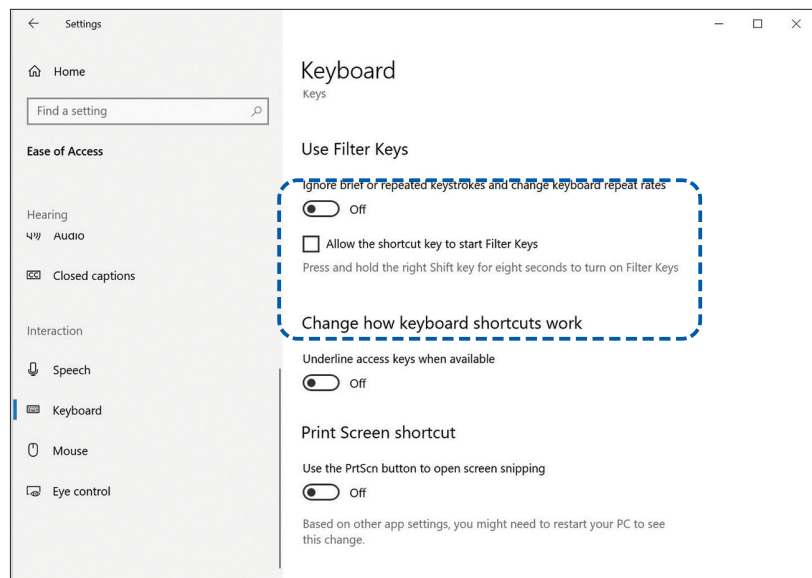Turning this function on brings up the advanced settings described below.

Figure 8. Filter keys

③ If the user unintentionally presses the same key multiple times, turn on "bounce keys" and adjust the waiting time before responding to the next keyboard operation when the
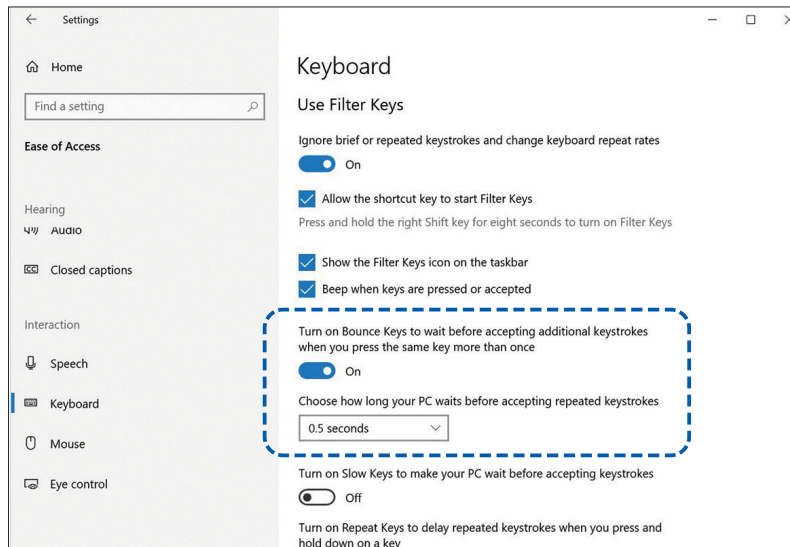
same key is pressed multiple times (Figure 9).

Figure 9. Filter keys

④ By turning on "slow keys," the user can adjust the waiting time until a response to keyboard operations (Figure 10). Hence, pressing operations for less than the set time will be ignored. With the "Slow down keyboard repeat rates" enabled, the user can adjust how long the computer waits to respond to the first iteration of a keyboard operation and how long it waits for the second and subsequent iterations to be recognized. In continuously erasing the characters before the pointer with the Backspace key, if users keep pressing the Backspace key, they can repeat the operation. As such, when set appropriately, users will not accidentally erase too much and can operate comfortably (Figure 10).
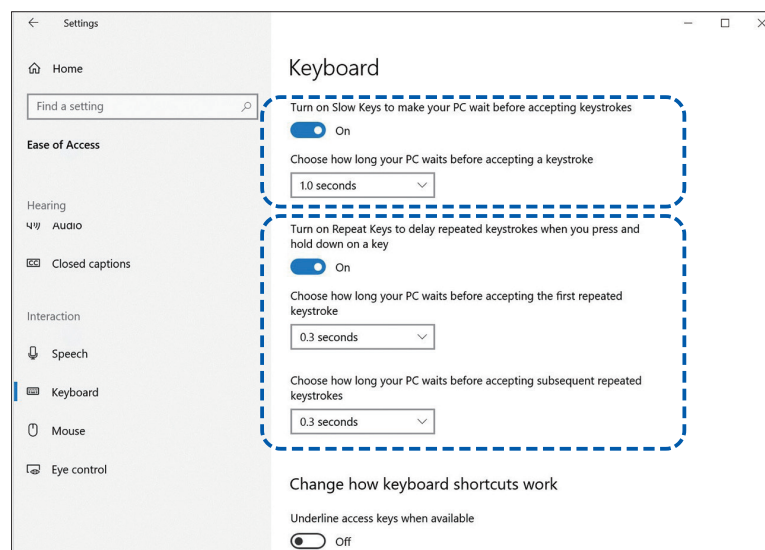

Figure 10. Filter keys (Slow keys and adjustment of repeat rates)

(2) Use OS settings (use screen keyboard)

Go to Start Menu > Settings > Control Panel > Ease of Access > Keyboard and turn on "Screen keyboard." The on-screen keyboard provided by Windows will appear, and the same operations using a keyboard can be performed using a mouse (Figure 11). Moreover, mouse operations can be replaced through the methods mentioned in "1) Operating a mouse."
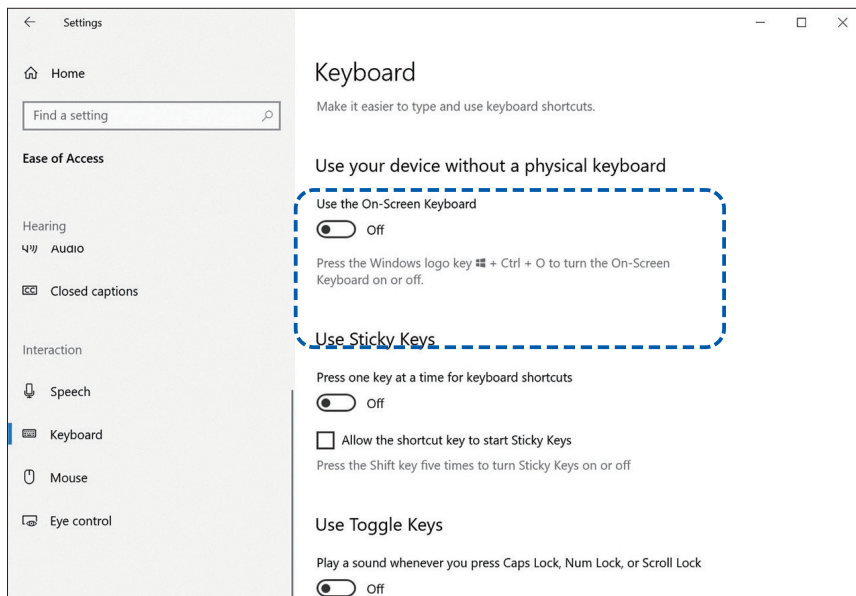

Figure 11. Using the on-screen keyboard

Select the key input method from the "option" key at the bottom right of the screen keyboard. Move the mouse pointer over each key on the on-screen keyboard and select "click key," "point to key," or "scan key" (Figure 12).
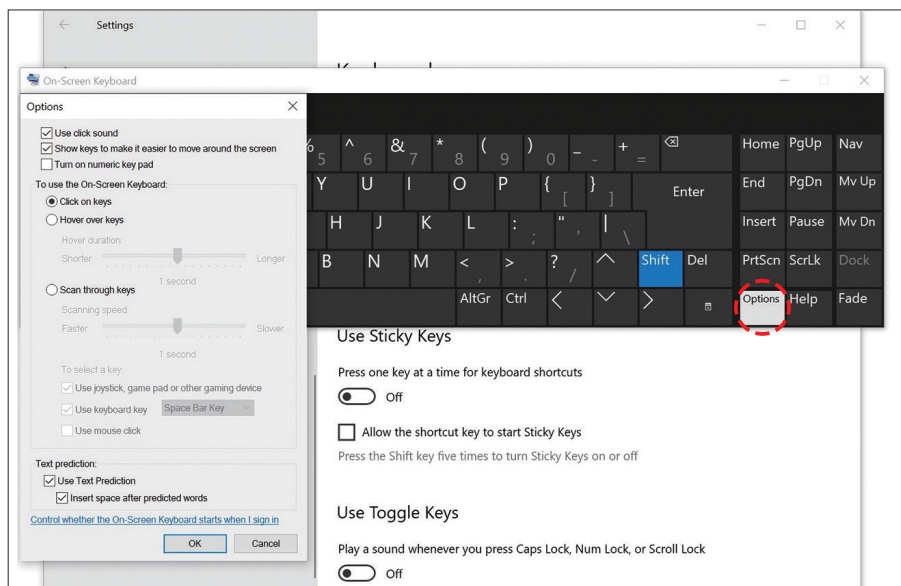

Figure 12. On-screen keyboard options (select input method)

"Click key" inputs the corresponding key by left-clicking with the mouse.

"Point a key" is automatically entered by moving the mouse pointer over the key that the user wants to press and leaving it for a set period, eliminating the need to left-click the mouse.

"Scan keys" automatically scan the on-screen keyboard screen by dividing it into blocks. The user can set the scan speed and which key (game device or mouse left click) to confirm the scan.

(3) Use OS settings (use voice recognition)

If the user can talk, they can operate their computer by voice by going to Start Menu > Settings > Control Panel > Ease of Access > Voice Recognition. Depending on the user's pronunciation, the computer may not recognize the user's voice. Thus, it would be best to check if it can properly recognize the user's voice.

Furthermore, not all operations can be performed by voice. Hence, this feature should be used to explore its limits (Figure 13).
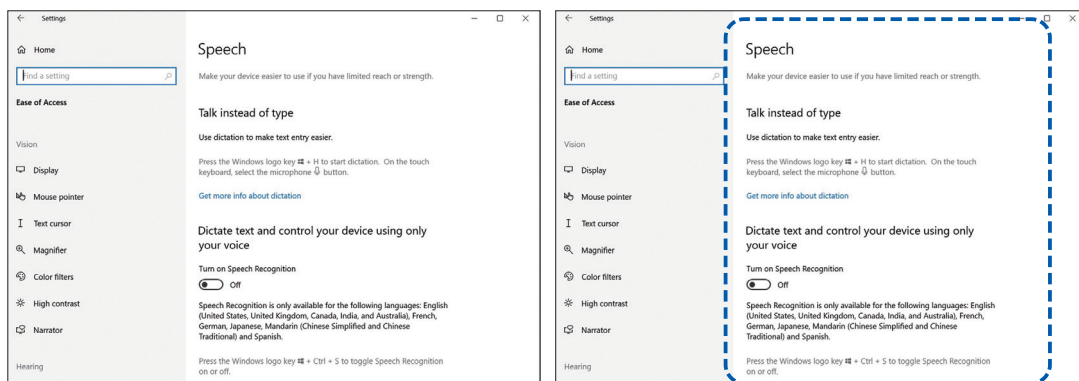

Figure 13. Operation by voice recognition (selection of input method)

(4) Keyboard operation using non-keyboard switch operation

If it is challenging for the user to use the keys of a standard keyboard, an easy-to-press switch can be used instead of the keyboard. The function of the connected switch is assigned to each operation of the keyboard in software to substitute the keyboard operation. If all key operations are to be substituted by switch operations, the same number of switches would be required, which is not realistic. Hence, it could be a substitute for major key operations.

・Dekimouse project "Dekimouse S2," Kawarukimi

　https://dekimouse.org/wp/kiki/dekimouses2/ (Japanese)

(5) On-screen keyboard

There are other on-screen keyboards aside from the on-screen keyboard provided by Windows OS. Use the user's favorite on-screen keyboard.

Use On-Screen Keyboard (OSK) for input (Microsoft)

Search with Microsoft OSK

PIGY software keyboard

http://www.atlantisdo.com/software/pboard/index.html (Japanese)

Regarding (4) to (5), there are several devices other than the corresponding products highlighted.

(6) Using a smartphone instead of a keyboard

The user can install the application software on their smartphone and computer and launch it with the same Wi-Fi connection, allowing them to type on a computer using a smartphone. Given that characters can be input with a smartphone using a narrow range of operations like flicking, this method can be used when a keyboard is not an option. A Wi-Fi environment is required, and functions differ per application software ; thus, it is necessary to confirm such factors.

・"Remote Mouse Pro"

https://itunes.apple.com/jp/app/id380450781?mt=8&ign-mpt=uo%3D4 (Japanese)

Chapter 3.
Operating a Smartphone and Tablet Device

Unlike a personal computer, operating a smartphone or tablet device is mostly performed by touching the screen, such as tapping and swiping. Instead of moving the mouse pointer and clicking on a computer, the user can tap on the screen (the mouse pointer becomes the tapped location). Further, these devices also require operations like pinching and swiping, making it challenging for those with impaired finger functions to use smartphones and tablet devices.

With the accessibility features of iOS and Android, these operations can be executed by tapping the icon assigned to each operation (iOS: AssistiveTouch) or operating an externally connected switch using the scanning method (iOS: Switch Control, Android: Switch Access) (Figure 14).
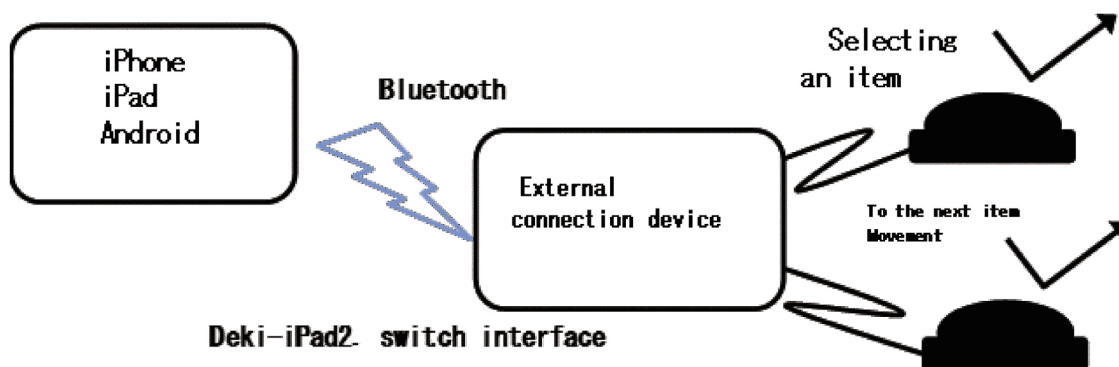

Figure 14. Operating using an external switch through the accessibility function of each OS
Easy-to-press button operation enables the operation of iPhone, iPad, and Android devices.

1) Operating an iOS device
Go to Settings > General > Accessibility and set the following features:

(1) iOS accessibility function (Touch)
The user can specify the duration of touching the screen before a touch is recognized from "Touch" and the duration in which multiple touches are treated as a single touch.

① Adjusting the "Hold Duration"

By adjusting the Hold Duration, the user can specify the duration of touch before it can be recognized by the device. A light touch will be ignored; hence, the user needs to touch firmly until it is recognized.

② Adjusting "Ignore Repeat"

Adjust Ignore Repeat to specify the duration in which multiple touches are treated as

a single touch. This is effective when users have tremors in their hands, making them unintentionally press two to three times.

https://support.apple.com/en-us/HT205269

(2) iOS accessibility function (AssistiveTouch)

When "AssistiveTouch" is turned on, the user can substitute operations by tapping the icon assigned to the operation. For example, a pinch-out operation (an operation of spreading the thumb and forefinger) to enlarge the screen can be assigned to one icon. Therefore, the user can magnify the display by touching the icon. Moreover, the user can set the operation for pressing the home button to return to the home screen and the operation of adjusting the volume by pressing the button on the side and tapping the icon on the screen.

A mouse pointer is displayed when a mouse device is connected using a Bluetooth connection or a Lightning to USB camera adapter. The location of the mouse pointer becomes the tap location, and when a click operation is performed on the mouse device, the location is tapped. It allows for efficient operation when a mouse device can be used. When the Dwell Control is enabled, the selected dwell action will be executed when the mouse pointer is stopped for the specified time. Thus, if tap is selected, the tap operation can be performed without clicking. Given that the "Home" icon is not displayed merely by connecting a mouse device, it is better to turn on "AssistiveTouch" for the operation to be done with a "Home" icon.

https://support.apple.com/en-us/HT202658

(3) iOS accessibility features (Switch Control)

One of the accessibility features, Switch Control, will be discussed here along with how to use it to operate iPhone, iPad, and iPod touch.

・iOS accessibility features (Switch Control)

https://support.apple.com/en-us/HT201370

When "Switch Control" is turned on, the user can operate their iPhone or iPad by operating an external switch. It is possible to regard the operation of touching the screen itself as a switch or use the front camera to use the direction of the head (movement to turn the head left and right) as two switches.

After pairing the prepared switch, go to Settings > General > Accessibility > Switch Control > Add New Switch > External and press the switch connected to the switch interface device for the Apple device to recognize it. Subsequently, it sets the role (switch action) for that switch. If "Screen" is selected, any place on the screen can be touched using a switch; hence, roles can be set. If "Camera" is selected, the user can use the direction of their head as two switches through the front camera.

If the user uses a product called "iPad Toucher," they can touch the screen by operating a switch. If the place the user wants to touch is fixed, such as the shutter button of a camera app, or if "Screen" is selected in Switch Control, the switch operation becomes a "screen touch."

・Assistec "iPad Toucher"
　https://assistech-lab.com/?pid=73139945

　For other iPhone settings and accessibility support, please refer to the following sites.

・Mac accessibility support
　https://support.apple.com/en-us/HT204434
・Switch Control and Accessibility Keyboard Guide
　https://help.apple.com/en-us/HT204434
・Accessibility (physical functions)
　https://support.apple.com/en-us/HT204434

2) Operating an Android device

Android also has a setting that corresponds to the touch function of iOS. It can be adjusted from Settings > Advanced Settings > Accessibility > Switch Access > Settings > Switch Adjustments (Figure 15).
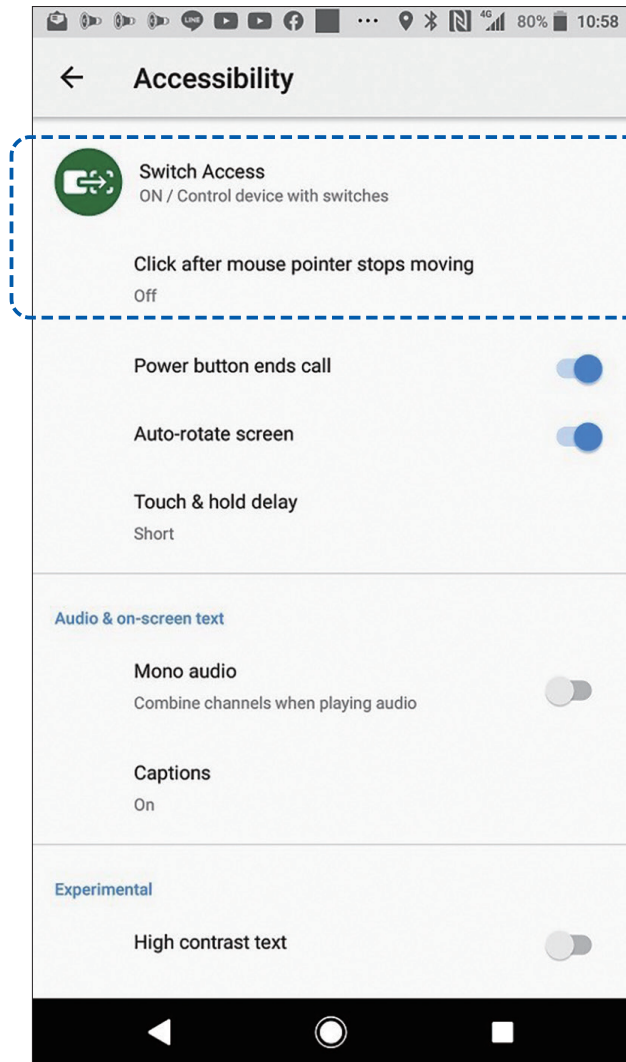

Figure 15. Android Switch Access, switch adjustment

Other settings can be found under Settings > Advanced Settings > Accessibility > Switch Access >
Switch Access/Settings.

(1) Switch allocation

Assign switches for scanning.

(2) "Scan Customization"

Set automatic scanning, scanning method (corresponding to iOS item mode), and point scanning (corresponding to iOS point mode).

Furthermore, please refer to the following sites for Switch Access settings and accessibility support.

・Overview of Android Accessibility Features

https://support.google.com/accessibility/android/answer/6006564?hl=en

・Connect an Android device via Bluetooth

https://support.google.com/android/answer//9075925?hl=en

https://support.google.com/android/answer/9075925?hl=ja

・Accessibility function menu

https://support.google.com/accessibility/android/answer/?hl=en

・Android Switch Access

https://support.google.com/accessibility/android/answer/6301490?=en

(3) Connecting a mouse

A mouse or trackball can be connected to the Android device using a USB conversion connector. Depending on the model, when connecting a mouse, a mouse pointer appears on the screen like in Windows. Thus, the user can move the mouse pointer and left-click to execute an operation that is the same as tapping. The user may also use a wireless mouse.

(4) Using an external connection device

Connect a "one-key mouse" to an Android device and use it. The method of use is the same as that used in Windows, and the user can operate an Android device with a single switch operation.

・TY Project "One-key Mouse"

http://www.ty-plan.com/03_fukushi/02_onekey/1keyusb00.htm

Index