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A Physical-touch System that Gives Folders and Data Physicality to Increase the Perceptual Effect on a Computer

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***Abstract*:** *Today, many people use their own digital devices. One major example is computers. They are becoming smarter and store more functions, and the convenience has increased immensely. On the other hand, they are designed to be very unitary, and it is not possible for users to feel the operations and functions in a visual and experiential way. In this research, we assume that we can establish a new interaction with computers by "physical touch," by which we perceive objects experientially in reality without being clearly aware of it. In particular, we propose a system to change the "feel of files of a computer" in which a lot of documents are bundled. For example, the smoothness of the dragging movement changes depending on the amount of data in the file. Files with small amounts of data are set to be 'light' and can be moved easily and quickly, while a file with a huge amount of data is 'heavy'. Even if the file is selected and dragged quickly on the interface, it cannot be moved at that speed, and it has to be moved slowly. This represents the weight and accompanying difficulty that comes along with the volume of actual paper documents, when holding them in reality. we reproduce this feature on a computer.*

Keywords: *Analog, Digital, Real World Interface, Interaction, System Design, Personal Communication*

1. Background

In recent years, a large part of our life has becoming rapidly smarter. A typical example is a Watch. A watch is a tool for checking time. In ancient times, sundials were used. Centuries later, mechanical clocks with numerals were invented. This has been miniaturized into the wristwatch of today. There are several types of watches today. The most familiar type is the analog clock, which has numbers arranged along the circumference inside a circle and shows the time with long and short hands. Another is the digital clock, which shows the time using only numbers. The other is the smart watch, which has various functions besides a watch. One example of a smartwatch is the Apple Watch. Its basic function is a 'watch', and it also has functions of a wallet, notifications such as beeper, and others. Some are also responsible for health management based on data on exercise and heartbeat. Some people do not carry a watch with them because the mobile devices that they have, including smartphones and tablets, always include a function that can display time. Watches themselves are becoming more digital and smarter. Besides, the function of a watch is now included in other smart devices and watches are losing its unity form. With the spread of the Internet, certainly, these smart products have become a part of our life.

On the other hand, there are a considerable number of people, who still find typical analog products important. Some reasons may be emotional, for example, the analog product is a gift from someone, and etc. However, it is thought to be mainly because of the fact that tangibility of the analog objects can be perceived by human's physical sense. For example, in the previous example of a watch, we grasp the passage of time by turning the crown to adjust the time to the exact time, and by recognizing with our "eyes" the movement of the second hand or the movement of the pendulum in a pendulum clock.In the case of a watch that internal structure is visible, we sometimes look at the watch to enjoy the movement of its gears.

In this way, in addition to the original purpose of knowing the time, we can also perceive time through external stimuli. In fact, even with digital devices and smartwatches, there are some that mimic an analog dial as a watch display or go to the trouble of sounding the second hand, which clearly indicates the importance of such analog features. We think that people can rely on the functions of digital devices physically by giving them, “physical touch”, which is the physicality of conventional analog products.

2. Purpose

Today, everyone has some digital devices as ordinary tools, and computers are on top of the list as the most important tools that play an important role in processing various work-related tasks and in our daily life. Computers appeared only less than half a century ago, and their history is quite short in the long history the mankind have. The first computer looks like a large box, and it was a specialized device without even a screen. However, within five years, ‘computer’ has become roughly the same structure as today's computers. More people came to be able to sense how to use computers, like "it works by touching" or "user action cause operation" even without fully understanding the mechanism. Thus, computers have become miniaturized.

In the 2000s, the mainstream was the products that focused on mobility. This further accelerated the trend toward “the smaller the better” computers. As they become downsized, the user groups are shifting from the limited number of experts to the more general public, and today, even children who can speak only fractured language, can operate them. On the other hand, it can be said that ‘more generalized’ computers mean ‘simpler’ computers. Because it is designed to be easy to touch for use, users can perceive their own operational action flatly, and the users cannot capture tangible sensations, quantity, feeling of mass, texture, and any clues for importance.

Even in the flat world of computers, we believe that we can represent a data/function interrelationship on computers in a new way, by enhancing operability and physicality through “physical touch”: giving data on computers the mass and physicality that have been lost due to “the smaller the better” technology and introducing “emotional weight" associated with data/functions. In this paper, we specifically focus on files and folders, which occupy a very large percentage of the computer data, and enable users to capture the mass of documents: arbitrary importance of data by “physical touch.”

3. Precedent example

The computers that we use on a daily basis contain a variety of files, including documents, photos, and videos. Some clues to identify them are by the name of the file or by the date and time that the file was used. To organize them, we also use ‘folders’ as an effective way. By arbitrarily naming a new folder and storing the target files in the folder, we are organizing the vast amount of data in our computers. In this research, we propose a new human interaction with the computer by modifying the appearance of folders by various elements of stored content and changing the folders behavior associated with them.

3.1. Proposal 1. Visual and rapidity changes with data volume

Tit is often the case there is a large amount of data that includes different types of files in a folder. However, to get an idea of how many files are stored in that folder, we have to check the numbers. Of course, depending on user computer settings, we may be able to see the file types and content from some information on folder icons. For example, content of an image file is reflected to a folder icon, as a similar image, although the quality is rough., We can remember folder content by connecting them to our memory. However, it is not possible to determine whether the file content is really just that one image file or the file actually contains several images. In short, we cannot know the amount of information in the file. Obviously it is more difficult to figure out content size of the folder, which is full of such files. Even the user, who created the folder can guess what kind of files are stored in it only from the name of the folder before opening it. In order to find just one single file, we often have no choice but to ‘open a folder to delete it’ again and again. When searching for a document on a computer, we look for it taking a guess which folder has a high degree of relevance. In reality, we tend to carry and

organize the documents putting together them into a binders or a ‘clear plastic folders’ in many cases. To find a certain file, people usually would look for the ‘clear plastic folders that they have used recently’, by taking the folders’ design and thickness as clues for the judge. There is a limit to the number of clear plastic folders that can be carried around at one time, and the ones that are not used are often organized and stored in the study. Sometimes the ‘clear plastic folders’ become so heavy that they are difficult to move.

In this research, we propose to reflect the characteristics of the ‘physical touch’, which we experience when handling data in reality, to the computer. For example, the visibility of the folder is increased in proportion to the amount of data in the folder. We propose a visual representation: lighter for folders that have just been created and contain little data, and darker for folders that contain a large amount of data. Besides the above changes, we add a design that visually represents ‘heavy’ to folders. There are many possible ways to express ‘weight of the folder’. For example, we plan the representation of a folder being embedded, as shown in Figure 1. We adopted the design that files containing a large amount of data will dent in the ground, so that people can feel the sensation of difficulty in lifting or moving heavy objects, which is common in reality, also when using a computer.

Regarding that operation of moving folders, another modification is incorporated. When moving folders, those with small amounts of data inside, can be moved quickly. However, when moving those with a large amount of data, they can be moved only slowly due to the weight, and their actual move cannot be linked to the quick operations performed by the user on the interface. To move those folders, it is necessary to operate at a speed that commensurate with their weight. We propose a visual and behavioural change of the folder in such a data volume.

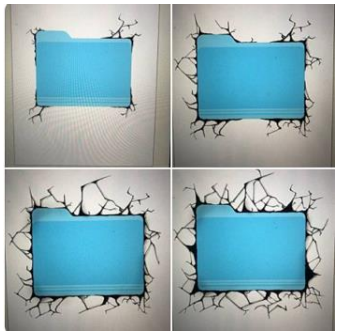

Fig. 1: Design of a file that is embedded on the ground by its weight.

3.2. Proposal 2. Change in security depending on the importance based on relevance to the individual

The data stored in computers is in a variety of formats and has different sizes. We do not keep track of the information of the data by some kind of numbers, such as the size of the file or the date, instead, we do rather by the ‘relevance of the content to ourselves.’ ‘relevance to oneself’ means how much the content means to him or her at the current stage. In reality, when we deal with documents in paper form, they are organized based on this ‘relevance’. Files that have little relevance to us at the current time, can trigger feelings of ‘nostalgia’. There is also a way to rename to manage files in today's computers. For example, we can add the word ‘important’ at the beginning. Another way is to include the date in the file name to make organizing and searching easier.However, since this is done only through personal settings, it may be convenient for an individual or a certain number of people, but less versatile. Importance based on ‘relevance’ is mostly attributed to personal reasons and timing. In reality, people manage documents by organizing documents depending on categories in appropriate ways; by using clear plastic folders or larger holders than envelops, by carrying around with them, by keeping in the study, and by locking the case sometimes. However, on the computer, those categories can be easily mixed up together. In this research, we focus on this point and propose to set the value of documents arbitrarily on a computer, and the value will change their operability and visibility.

When we manage important documents, we often keep them in a designated place or lock them up so that others will not see them unintentionally. However, such a feature does not exist in computers. In this research, we propose the system that enables the user to capture visually and experientially the important documents on the computer by arbitrary specification. On today's computers, users can attach tags to files, which can be colored or arbitrarily named to indicate their importance or marks. This function can be extended in the way to give visual changes when files specified by tags are in a folder. For example, if there is a lot of data with red tags in a folder, the folder will turn red. This makes it clear where the files specified the importance by the user are located, and it leads to easier data organizing. However, this also makes it obvious that files with some meaning or importance for the owner, are stored in that folder. Therefore, we set a different operation from the usual to open that folder. One method is to use of passwords, like unlock a safe by combination of numbers. However, since the focus of this study is on "physical touch", we propose to apply this to set the different operation.

For example, a folder is usually opened by double-clicking, but a folder containing files with tags or specified by other ways, are opened by a certain number of clicks. The number of click times can be specified arbitrarily. Or we also plan to change the number of click times, depending on the number of the files with tags in a folder, in addition to double-clicking. If there is only one file with a tag in the folder, it will be opened by double-clicking plus one, and in total, by three clicks. If each subsequent 10 units (the number of files with tags) require '+1 click', a folder that contains 24 files with tags can be opened with 5 clicks. Another way to open folders is by combining the timing and rhythm of the clicks and the number of fingers. For example, 'one clicks with one finger, and then double click with two fingers' or 'click with the rhythm, '♩♪♩'. However, this way can be set completely at the user's discretion, because giving the method regularity would make it easy for anyone to open the folders.

3.3. Proposal 3. Changes that occur over time

It is no exaggeration to say that documents on a computer is semi-permanent. If the computer itself is not damaged or the data is not faulty, the documents will not deteriorate over time, which frequently happens in reality. However, it is difficult to manage such a huge amount of documents because their form is data. All of the folders that are currently implemented in many computers are have the unified standard form. In some of the folders, there are old documents or unnecessary files that have not been opened for a long time. On the other hand, there are some folders that are opened every day. We propose to apply the degradation over time to folders on a computer and enable users to visually capture the difference in use frequency.

Specifically, the opacity of the folders that have not been opened for a while, will be decreased and they will gradually become invisible. At the time of creation or use, the opacity is (becomes) 100%. However, if a folder is not opened for a day, the opacity will be 99% the next day. In a few days, the difference will be almost imperceptible. However, after a long period of time, visual changes can be capture as shown in Figure 2, and the folders that have not been used for about three months will disappear. In Figure 2, a month is defined as 30 days. Definitely, this function is only a visual change and does not affect the files themselves, it is possible to check the data without losing it. However, in order to access that data, users cannot go through folders, instead, have to search from many files, taking dates or file names as clues. We believe that by making these changes, users will be able to reaffirm the importance of the documents that they regard as important on a daily basis and they can organize unnecessary items more smoothly.

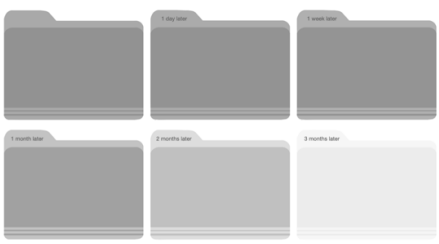

Fig. 2: Change in opacity over time.

4. References

This research proposes to reproduce the physical stimuli that we take for granted in the real world, in a computer, so that we can perceive digital objects more proximally. There is a similar study, which is about the Real World Interface. Another relevant research is a research based on the reversal idea of bringing computers and other digital devices closer to reality, and a typical example is Haptics. In this chapter, we summarize and review representative examples of those studies.

4.1. Real World Interface

An interface that focuses on operating computers and digital systems using realistic actions and usages is called a Real World Interface. For example, we are not familiar with typical interfaces such as keyboard and mouse, which are tools that we need to learn how to operate to use a computer. In our daily life, the information and interactions on computers and the Internet are something in virtual space, and there is a boundary between them and the real world. However, the convenience of computers has made us increasingly dependent on them, and nowadays it is difficult to live life without them. We focused on Real World Interfaces as prior research examples in light of this research background. Some insights into representative examples are summarized below.

Tool Device: Real World Interface using tool metaphors [Japanese](2003) proposed a device that enables familiar operation by using tools that we use in our daily lives, rather than using a keyboard or other specialized device to exchange data with a computer. For example, we understand the specifications of the syringes that we have seen and experienced commonly from an early age during vaccinations and medical tests. Focusing on this, the research team proposed to use the “suction and push (injection)” motion of a syringe to handle information. Place the tip on a touch panel display or photo paper as shown in Figure 3 and pull in the direction of the arrow as if suctioning, to get the information into the syringe-type device. Then, as shown in Fig. 4, the tip of the device is placed on the special inlet of the printer or computer, and the information is read by injecting action.. It is also possible to combine multiple data by “sucking” them into a syringe device and “shaking” it. This is also based on the manipulation in reality of mixing composites. They have also focused on the absorption of liquid of sponges used for cleaning and washing dishes. They also devised the device that absorbs data by contact and outputs data by squeezing or a tweezer-shaped device that handles information by "pinching and releasing" motions.

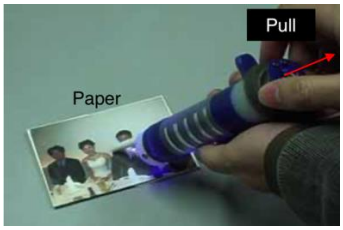

Fig. 3: Suction of image data from paper (Ref. [1]).

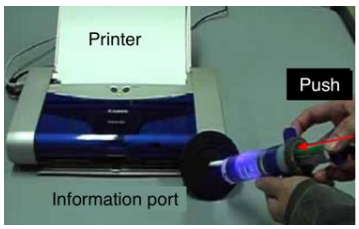

Fig. 4: Injecting data into the printer (Ref. [1]).

It can be said that the goal of authors’ research is no different from that of a Real World Interface. The research on Real World Interfaces proposed new devices for manipulating computers and new ways of

interacting with them based on metaphors of real-world tools. In contrast, our goal is to create a sense of reality within the existing computer environment. Rather than relying on tools based on experiences that are taken for granted in the real world, we use ‘physical feedback’, even on computers. By this way, our research aims to eliminate the difference between reality and the computer, which is a virtual space. Thus, it has many points similar to Real World Interfaces, but essentially our research has methodological difference with Real World Interfaces.

4.2. Haptics technology

In recent years, there has been a lot of research on how to operate computers intuitively. One of the factors for intuitive operation is the sense of touch. Of course, in terms of taking in information, visual and auditory senses are highly important because seeing and hearing are considered to be important. However, most of the cases when we do some work in reality, we use our hands. We write, draw, and create by hands. When we work with a computer, we use our hands to use the keyboard and mouse as the interface, but it is only an ‘operation’, not a direct action that corresponds to the actual work. Also, the sensation of “touch” is constant and unchanging. In real life, the brush pressure changes as one concentrates on writing/drawing or presses hard on the pencil, creating the style and delicacy of the work, but regarding operation by a hand on the computer, this kind of change is not seen. It is difficult to stimulate our senses because we have to use the interface as ‘medium’, instead of simply working intuitively and directly with our hands. Haptic Technology, which uses acoustic radiation pressure to generate ultrasonic waves, has been used since the 1970s to create a sense of touch in computers. In recent years, it is often used mainly in virtual spaces such as VR and AR. When there is a virtual space in front of us, we may have the experience of reaching out to touch virtual objects, even though we know that it cannot be actually there right in front of us. Haptic technology gives people a sense of touch and makes them more aware of virtual objects’ existence. In other words, the research on Haptic Technology propose to work with computers and digital terminals, including virtual spaces, by using people’s ‘hands’, which they use everyday. Typical examples are "VRgluv" and "DextrES". Both are shaped like a glove and have sensors attached to enable intuitive work in a virtual space. The glove also provides a stimulus to create a sense of reality. Figure 5 shows "DextrES"

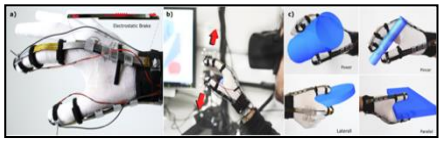

Fig. 5: DextrES (Ref. [2]).

In respect of what this research and haptic technology aim to achieve, both share the same purpose, sense of reality. However, the “physical touch” focuses on enabling people to capture physicality changes through operational movements and sense of vision. On the other hand, Haptics specialize in the sense of touch, which leads to sense of reality by creating an illusion.

5. Conclusion and future work

Today, we use a variety of digital devices. Many people have their own devices, including smartphones, desktop computers, laptops, and tablet devices, and some people use multiple devices for different purposes. It is obvious that our life is becoming smarter because smartphones have not only phone functions but also notes and calculators, moreover nowadays they often work as wallets. Particularly, regarding computers, it is very convenient to be able to organize a huge amount of data as a user wants and mobility is also handy without

changing its actual mass, no matter how much the data increases. However, it is difficult for the user to grasp the importance of each data and its relevance to him or her visually and experientially. Because all of these devices are designed in a clear and concise manner to be easy for everyone use. In this research, we focused on folders: an effective mean of organizing documents on a computer, and proposed the concept of "physical touch" to solve this problem. The formulated changes of the folders are just some examples. We have presented several ways to make "physical touch" effective for folders, but we are currently under discussion whether we will implement all of them at the same timing or focus on some. Also, the choice of computer as the target device is only one possible alternative. As future tasks, the prototype development based on this paper is planned and subject experiments will be conducted to prove and improve the usefulness and reliability of this research. We will also focus on 'tools and functions that are becoming smarter' from various perspectives, besides folders on computers, and propose a variety of approaches.

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