Design of E-mail Client Interaction (MCI) System for Representing Physical Movements through Gesture-initiated Pressing Operations

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Summary
While the advancement of digital technologies is making our life more convenient, the sensation we feel while using analog tools or contrivances might be lost with digital devices. It negatively affects the joy of or motivation toward using digital content, and often causes various problems related to content use when user's awareness declines due to the lack of sensory reality. For example, while we can conveniently send an email with a single click with today's email clients, we often experience email issues such as sending one to an unintended recipient due to mistouching or using a wrong address. This is caused by 'sending an email' with a single click, which deprives the user of the sensory reality of the operation. This study focuses on the email client interface and aims to represent the sensation of mailing a letter by integrating the pressing gesture operation. In this paper, we propose an email client interaction (MCI) system which realizes physical movements of 'sending a mail/holding out a letter' by the 3-dimensional, pressure-sensitive functionality (3D Touch). We also design an email interface to be operated only by gestures, featuring a 4-direction display interface, and devise a mechanism to detect / notify mistakes in the email content, using the function to give feedbacks of different pressure intensities. The study emphasizes the sensory reality of emailing tasks by integrating above functions and proposes a method to prevent email mistakes by improving users' awareness while emailing. Thus we present and consider a possible design method, which incorporates an element of sensory reality

Key words:
Interface Design, Interaction Design, Gesture, Smartphone Application, Email Client.

1. Introduction

Interface designs for digital devices have become more diverse in recent years. In addition to the conventional design methods such as Character User Interface (CUI) and Command Line Interface (CLI), interface has evolved into diverse designs including Graphical User Interface (GUI), which is characterized by the use of mouse and icons, and Natural User Interface (NUI),which uses touch, gesture and voice (1). Especially, integrating multiple interfaces in a single device has been a trend, which meets the different needs of users.

With regard to smartphone, which has come to dominate our life in today's information society, NUI is particularly attracting public attention as an interface that perfectly provides 'convenience', a factor that characterizes the device. The design concept of NUI advocates 'realizing the natural interaction with machines', which has a significant influence on smartphone content development. Ideas such as 'intuitive operation', 'natural user experience' and 'efficient use' are also considered crucial in application design (2).

This study particularly focuses on an interface design that uses gestures and devises a new design method based on the examination of precedent examples. There is a clear distinction between the proposal and the idea of intuitiveness emphasized in precedent concepts. From a new viewpoint of "reality "that a user experiences through the interface, this proposal attempts to create a realistic sensation of using objects by making the gesture operations reflect the body movements of the user.

Digital devices like smartphone excel in functionality and convenience, but lack the realistic sensation of using objects (3). For example, smartphones can store tens of thousands of digital books and enable users to read them anytime, anywhere. Reading on smartphone, however, does not give users the same real reading experience as paper books do. The lack of sensory reality is the factor, which deteriorates the user experience not only on smartphone but also on all types of digital devices (4).

Taking the example of email clients which people use every day, this study proposes an interface controlled only by gestures. The design emphasizes the realistic sensation of "sending a mail" in addition to intuitiveness and convenience of gesture operations. We thereby consider creating an interaction that integrates the element of reality and explore the possibility of a new digital content design method.

2. Background

2.1 Challenges of email communication

Email has become an indispensable tool for today's communication. While the use of email provides great convenience, it has some daunting challenges. To be

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specific, problems such as misaddressed emails, email content mistakes and failed attachments occur frequently (5).
Solutions discussed include double-checking the email content before sending it, using BCC/CC functions and encryption (5). However, none of them would lead to a complete success unless user's carelessness or lack of awareness is managed. Therefore, to solve the issue of email mistakes, it is important to control users' lack of attention and to raise their awareness while emailing.

2.2 Examination of solutions

To prevent emailing mistakes from happening, no other way is as effective as boosting the attention of the user who uses the email software. In tackling the problem, this study incorporates the mistake prevention method into the emailing tasks and aims to enhance users' awareness. With this method, users would have to be more aware and attentive, which we think would keep emailing mistakes from happening.
To improve users' awareness, it is essential to enhance the 'sensation of performing tasks', which lacks in the conventional software. For example, the realistic experience of 'sending a mail/letter' - writing and mailing a letter physically - lacks in the tasks of emailing on digital devices such as computer or smartphone. With current email clients, sending an email is just one click away, but this is prone to mistouching.
On top of this, users tend to send emails without carefully checking the content and address. If the sensory reality of body movements to mail letters could be incorporated into this process, users could perceive the sensation of the task every time they perform the operation. The sensory reality they experience each time should naturally increase their attention to the tasks they are performing. As a result, users would be more careful not to cause mistouching and proactively check the email content and address.
User's inability to feel the sensory reality of physical mailing causes a state of reduced awareness and emailing mistakes. To solve this problem, an email client that emphasizes the sensory reality of mailing and functions as an awareness booster is needed.

3. Proposal of Design Method

3.1 Consideration of gesture operations

Today, touchscreen gesture operations on digital devices such as smartphone are being widely used. With different gesture operations including tap, flick, swipe, and touch and hold, usability of the devices has dramatically improved (6). The advantage of gesture operations is the intuitiveness which enables users to instantly learn how to operate the device and use it immediately (7). For example, anyone can intuitively understand how to display the pictures on the screen by scrolling them from left to right where pictures are arranged side by side. Also, we need no instructions for scrolling the screen to get information when we read a long text on web browser or ebooks.
That is because the body movements that involves 'use of objects' like everyday tools, contrivances and machines are incorporated into the gesture operations (8)(9). In short, gesture operations deliver ease of use and intuitiveness by reflecting the sensations from natural movements we make in everyday life. For this reason, gesture operations performed by body movements provide a realistic experience of using objects more effectively than conventional interface methods such as pointing device and keyboard or next-generation interface methods such as voice recognition and eye tracking (10).
However, the interfaces of existing email clients depend on pointing operations like clicking or tapping. Therefore, this study focuses on the potentials of sensory reality that gesture operations provide. It also devises and designs an email client, which represents the realistic experience of mailing work.

3.2 Realization of realistic interaction

Though gestures represent physical movements, it does not mean they give users the 'actual experience of the physical movements'. For example, users turn the pages on a smartphone book app by swiping the screen. While the 'swiping' operation might give users the perception of physical action, they could not feel the sensation of turning the pages of a real paper book. In other words, smartphone apps provide a virtual user experience, but not an 'experience of using a real object'.
There certainly are some attempts that are successful in providing digital content with realistic experience using analog-like approach. For example, Nintendo Labo, developed by Nintendo, uses a game device controller that is fitted into the cardboard models of fishing rod, car steering wheel or telescope. It then recognizes user's gestures through its gyro sensor so that the game content reflects these movements. Thus it provides a realistic gaming experience to allow users to feel as if they were actually fishing, driving a car or viewing through a real telescope.
The authors have also proposed methods to represent analog-like reality on digital devices. These include a scheduling method which adopted the time perception as represented in mechanical clocks, a method to represent the sensation of operating analog cameras on smartphone application, and a digital design that realizes the sensation of reading paper books (3)(4)(11)(12). These attempts are drawing public attention as harbingers of new possibilities in the field of digital content design. Interaction designs based on body movements such as this one enable users to

find joy in using the content through the perception of reality, get motivated and have a better user experience.
In this study, the body movements to 'send an email' will be represented through gesture operations based on the motif of daily practice/action of writing and mailing letters. While the precedent gesture-based interfaces emphasize the sensation of operation and functionality, this study aims to construct a user experience that comes with the sensory reality of body movements.
In short, it attempts to provide users with the sensory reality of 'mailing a letter' on Email Client Interaction (MCI) System which has incorporated the physical movements users make when 'holding out a letter to a recipient'.

4. Design of Email Client Interaction (MCI) System

4.1 Mechanism of MCI

The platform of MCI is targeted on iOS operation system provided by Apple, and the specifically targeted devices are iPhone. The application is designed by Xcode, the integrated development environment by Apple.
MCI mailing functions were developed by applying MessageUI, the framework for iOS equipped in Xcode. For that, MCI is not implemented as new single email client application, instead, it incorporated the basic functions of mail transmission and reception, content input and deleting based on MessageUI framework. However, to construct the interaction system for enhancing the sensory reality toward mailing tasks, the interface and required operations were designed to be based on the gesture operations devised in this study.
Figure 1 shows the MCI mechanism.

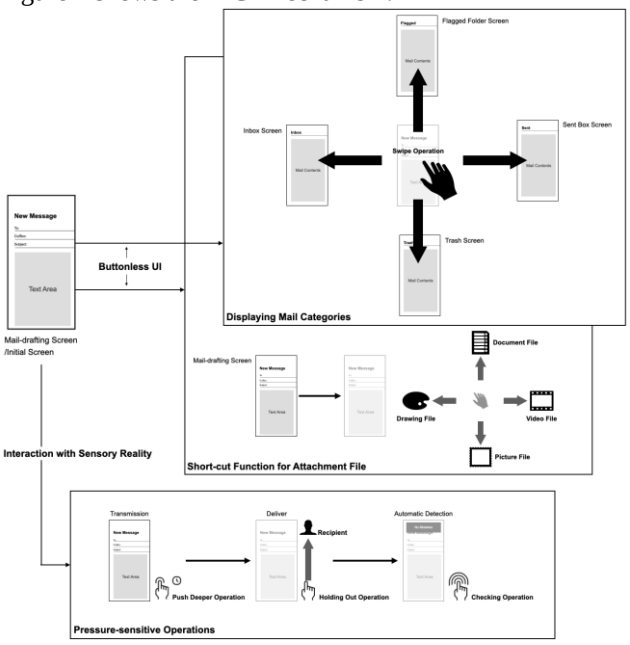

Fig. 1 Mechanism of application.

The all operations for MCI are based on gestures for the reproduction of reality in mailing tasks. The gesture operation of mail transmission is performed with the 3D Touch function that causes 3-dimensional sensation by pressure-sensitive operation: 'push deeper' to represent the sending practice of 'holding out a mail to a recipient.' The automatic checking function for mail content by AI is also integrated to present the mail adequacy by the feedback of pressing operation.

4.2 User Interface Design in MCI -thorough buttonless interface-

The interface design of MCI aims to bring out the maximum convenience of gestures. For the purpose, all the operations adopted in conventional email clients: sending mails with buttons or icons, proceeding to /returning to the following/previous screen, and switching 'inbox' and 'sent' are all replaced with gesture operations on MCI.
Recently, the design concept of 'button less' has spread in the field of interface design (13)(14). Many design examples just replace few buttons for particular functions with other interface operations (mainly gestures). For example, users can draw a heart figure of on the screen, instead of clicking on buttons, to execute the "like" function, on SNS to show the favor for the applied posts. However, the thorough button less interface like this proposal, on which users can control all the operations by gestures has not appeared yet.
Figure 2 shows the explanation for MCI button less interface operations.

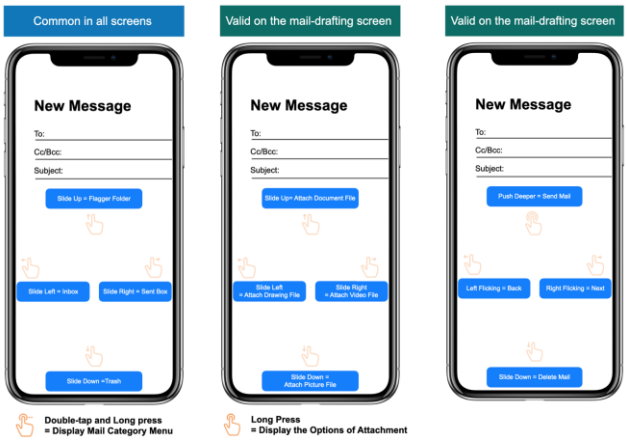

Fig. 2 Buttonless interface in MCI.

In current stage, MCI is designed for iOS system of iPhone so that the operations for application are devised with the reference of gesture operations on iPhone by default. Here the interface operations on the main screen: mail-drafting screen are described.

As well as the iPhone's general operations, by right/left flicking, you can operate the functions: 'proceeding one step forward (to next screen)' and 'going one step back (to previous screen)', namely, 'next' and 'back' to display emails stored in inbox, sent, flagged folder, and trash.
In ordinary email client services or applications, there are screens of inbox, sent box, flag box, and trash for each, and the common interfaces require users to click or tap each category to switch screens. Therefore, the repeated operations of multiple screen transitions are necessary. For example, when users have to check mails in inbox and flag box in succession, they need to "click inbox button" → "switch to inbox screen" → "click back button" → "switch to mail category screen" → "click flag box button" → "switch to flag box screen". In contrast, MCI has 4 directions display interface design to implement the seamless screen transition.
4 directions display interface refers to the interface design that activates the transition functions without the limitation of application layout and the running screen, instead of operating functions with buttons or icons, which are the elements of interface placed on the fixed positions. MCI applies 4 directions display interface to display the mail categories and to operate the attachment function.
The operations to display mail categories are set as common in all screens. If you double-tap and then long press on any position of screens, the mail category would be displayed. When you swipe their fingers to 4 directions: vertical and horizontal ways with your fingers attached on the screen, it would be switched to the different mailbox according to the direction you have swiped. As shown in figure 2, MCI configures the vertical operations as flagged folder (up) and trash (down). On the other hand, the horizontal operations correspond to inbox (left) and sent box (right).
In contrast to the common display for mail categories, the short-cut function for choosing attachment file is only valid on the mail-drafting screen. In the case, the options of attachment would be displayed when you long press any position on screen. The attachment functions are specifically designed as attaching document file (up), attaching picture file (down), attaching drawing file by handwriting (left) and attaching video file (right) according to 4 directions swipe operations.
You can properly utilize 4 directions display interface on each displayed screen at the moment. Instead of the placement of buttons and icons, the 4 directions display interface enables you to quickly select the functions that you want to operate with minimum effort whenever you like. The display design also functions to improve the efficiency of communication in application and to simplify the indications on the interface.

4.3 Interaction design of MCI -design of gesture operations to send an email with sensory reality-

MCI constructs the interactive email transmission system based on 3D Touch (pressure-sensitive) operations.
Figure 3 shows the image of transmission operations.

Fig. 3 Mail transmission based on 3D Touch.

3D Touch is the function detecting the degree of strength pressed on the screen and then displays the preview screen or particular menus (softbank, 2018). The major application of 3D Touch could be cited as changing the thickness of line according to the strength pressed on screen when users handwrite figures, displaying the quick menu to present the frequently used options when users press deeper strongly on the icon of application displayed on the home screen of smartphone, and displaying the picture largely in new window.
3D Touch is different from other smartphone gesture operations like sliding, tapping and scrolling in terms of the 3-dimensional sensation of 'press deeper to the back of the screen.' This kind of spatial sensation simulates the perception regarding recognizing and using tools and improves their user experience (15). For example, it has been proofed that the new usage could be devised by combining objects based on the perception of 3-dimensional spatial sensation and thereupon the problems could be solved in a smoother way.
MCI utilizes that 3-dimensional operational feature of "press deeper" by 3D Touch and represents the practice of "holding out a letter = sending a mail". People post letters with the sensation that they hold out them to the recipient. On the other hand, the gesture awareness of sending/holding out mails to recipients is lacked regarding the precedent email clients due to the fact that users can send mails by just once clicking the send button. It frequently causes the mistakes of incorrect email transmission like misaddressing. Therefore, MCI improves the gesture awareness toward mailing tasks by incorporating the gesture operations of sending mails utilizing pressing deeper on 3D Touch function to represent the sensation of holding out mails to recipients.
Moreover, to accurately prevent the mistakes in addressing, MCI designs the transmission interaction: the gesture

operations inspired by the physical movements of "holding out mails" to recipients.

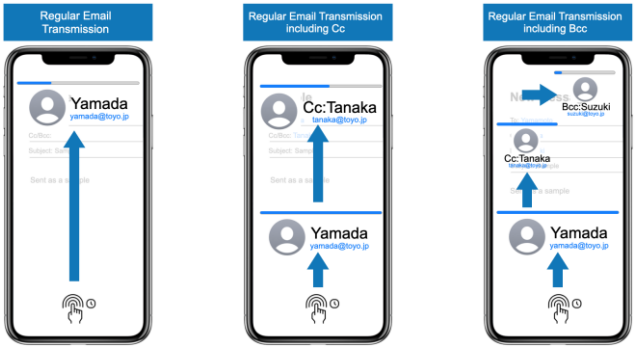

Fig. 4 Mail transmission gestures inspired by physical movements.

There are 3 types of email transmission in users' daily mailing tasks. First, 'regular email transmission' with which a user sends mails directly to the addresses of recipients. Second, 'email transmission including CC' which is used to deliver mails to other recipients besides the main address. Third, 'email transmission including BCC' is aimed to protect the personal information of each recipient's email address and to keep secrecy about the fact that the applied email was also sent to multiple addresses other than a recipient.

MCI devised the proper gesture operations for each email transmission type representing 'delivering to recipients'. For the type 'regular email transmission', when you press the screen deeper and the transmission mode is activated, you are required to slide to the recipient's address and check it for 3 seconds. At that moment, the gauge presenting the elapse of 3 seconds will be displayed and when 3 seconds have passed (gauge became full) the email will be sent.

For the type 'email transmission including CC', the check for CC recipients' address is required in addition to the gesture operations for the type 'regular email transmission.' Moreover, the operation designed for the type 'email transmission including BCC' requires you to check the BCC recipients' multiple addresses for 3 seconds by sliding to those addresses after long pressing on the screen.

As mentioned above, MCI designs the interaction system with sensory reality for emailing tasks by representing the physical movements of 'handling and holding out a mail to pass to the recipient.'

4.4 Interaction design of MCI -mail checking function by pressure-sensitive operation

In MCI, 3D Touch is applied not only to improve the reality of email transmission, but also to the function to check and notify the mistakes of an email.

Figure 5 shows the image of the interaction.

Fig. 5. Mistake check with 3D Touch.

The mistakes of incorrect email transmission are mainly categorized into 3 types as the misentries of address, mistakes in mail content and mistakes regarding attached file. MCI provides the function to detect the mistakes in the email components, which you have prepared to send by collating past email history.

For example, when checking the recipient's addresses, MCI functions to search the replied email history up to now and acquires the addresses of replies. Thereupon it detects the matching degree through the comparison between acquired addresses and the recipient's addresses in the email, which you have drafted. If there is no match, the addresses in the applied email would be judged as the mistake of the address. It would be effective for the cases of long email threads with a pile of replies like "Re: Re: Re: subject".

The mail content checking function is designed with the algorithm applied to ordinary document proofing functions to detect the mistakes regarding document processing in respect of grammar and spellings. The mistakes in regards of attached files are detected on the file name and format. First, we have system learn some particular keywords such as 'document', 'report' and 'picture' and the data formats that corresponds to those keywords. For example, 'document' and 'report' are connected to the data format of '.doc', '.xls' or '.txt.' On the other hand, the keyword, 'picture' corresponds to the image data format of '.jpg/.jpeg' or '.png.'

The automatic checking function determines the matching degree between the attached file and the drafted email by examining the attached file's data format based on the recognition of keywords in email content and by searching the related words to the attached file name from the received email history. MCI designed particular feedback types to users' operation depending on different mistakes. The most critical mistakes are set as the incorrect mail address and attached file, and the subtle mistakes are set as grammatical and typographical errors in email content. If there are no detected mistakes, it would be judged as 'no mistakes.' The system reflects those 3 levels of results to the pressure

strength of 3D Touch and represent it to users along with the notifications on the application.

If the mistakes regarding the address and the attached file have been detected, you cannot send the email despite of your push deeper operation. If the subtle mistakes have been detected in regards of grammar and typographical errors, send operation can be executed if you press deeper 1.5 times as strong as normal. If no mistakes are detected, you can send the email by press deeper operation with the normal strength.

In this way, to prevent the problem of incorrect email transmission, MCI designed the gesture operations representing the physical movements of holding out a mail and the sensory reality for emailing tasks based on the 3D Touch pressure sensation, which reflects the level of the mistakes regarding the drafted email.

5. Conclusions

This study proposed the email client interaction system that works only with gesture operations. The emphasis of the study is not the intuitiveness regarding operations, which is considered to be crucial in conventional interface design concepts, but the representation of the realistic experience of handling the mail as a tool. For that reason, we proposed the method for a new interaction design that incorporates the physical feature of gesture operations and 3-dimensional sensation of pressure-sensitive operations into the buttonless interface. The design focuses on the new approach/usage to utilize the existing technologies in order to meet users' needs rather than the further advancement of the present technologies.

Therefore, this new design method's demonstration is necessary as a future work. Certainly it is clear that people tend to prefer using something with 'real feel.' It is worth for verification to find what kind of new changes would be caused in people's lifestyle, if such idea, which is almost general phenomenon were applied to the use of digital devices. So the subject experiment regarding MCI would be held in the future.

We also attempt to develop the design concept to produce sensory reality for wider fields and advance it as a mature systemized design theory. The aimed theory would be applied not only to the digital content design as smartphone applications but also to digital device design and general computer engineering. We indicated the possible new direction by the theory through this paper as the outset.

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