Augmented Typing: Augmentation of Keyboard Typing Experience by Adding Visual and Sound Effects

Tsubasa Yumura
Japan Advanced Institute of Science and Technology
Nomi, Ishikawa, Japan
tsubasa.yumura@jaist.ac.jp

Satoshi Nakamura
Meiji University
Nakano, Tokyo, Japan
satoshi@snakamura.org

ABSTRACT

People make choice of a keyboard for various features such as key arrangement, repulsion strength, stroke depth, and stroke sound. Currently these features depend on hardware; however, if a physical keyboard can be customized with software, users will be able to arrange it as their preference. In this paper, we propose augmented typing that augments typing experience by adding a visual and sound effect to a physical keyboard. We implemented a prototype system of the proposed system using projection mapping. To determine the effect and the usefulness of the system, in addition, we conducted evaluation experiments. Results of the experiments showed that the evaluation of sound effect was more variable than visual effect; users found that visual effects are beautiful, whereas the sound effects to be annoying.

CCS CONCEPTS

• **Human-centered computing** → *Keyboards*.

Asian CHI Symposium'19, May 2019, Glasgow, Scotland, UK

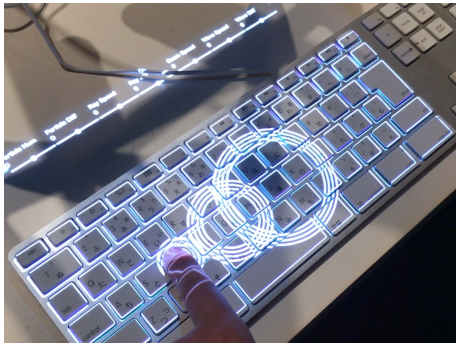

Figure 1: Overview of Augmented Typing.

KEYWORDS

Keyboard; Typing; Projection Mapping; Augmented Reality; Mixed Reality

ACM Reference Format:
Tsubasa Yumura and Satoshi Nakamura. 2019. Augmented Typing: Augmentation of Keyboard Typing Experience by Adding Visual and Sound Effects. In *Proceedings of Asian CHI Symposium '19 (Asian CHI Symposium'19).* ACM, New York, NY, USA, 7 pages. https://doi.org/10.475/123_4

INTRODUCTION

The keyboard has been the mainstream of character input devices since the widespread use of personal computers. Many people select physical keyboards based on various features such as key arrangement, repulsion strength, stroke depth, and stroke sound. This tendency is particularly common among software engineers as they often choose characteristic physical keyboards such as Happy Hacking Keyboard[14] and Kinesis Contoured Keyboard[10]. Additionally, they may arrange their physical keyboard keys themselves to their liking by replacing key tops or attaching covers. For PCs and smartphones, users can arrange various settings by software, such as an image of the standby screen or the ringtone music. Conversely, software engineers edit the setting file of a text editor such as Emacs and Vim and rearrange their appearances and functions. Currently these features depend on hardware; however, if physical keyboards can be customized with software, users can arrange them as their preference. Other possible ways of arranging a physical keyboard include playing an audio file according to keystrokes, playing a favorite sound as a key striking sound, displaying a visual effect on a physical keyboard, and playing sounds or displaying visual effect on the physical keyboard in synchronization with keystrokes. Herein, we propose augmented typing system, which augments typing experience by incorporating visual and sound effects on a physical keyboard. We implemented a prototype of the augmented typing system using the projection mapping. To measure the effect of the system on users, we conducted evaluation experiments.

AUGMENTED TYPING

The proposed augmented typing system augments typing experience by adding visual and sound effects over the physical keyboard (Figure 1). The proposed system aims to add euphoria and comfort in the monotonous work of typing, such as in PingPongPlus[6] and OpenPool[8] expanded sports. If typing is imparted with visual effects, keyboards glow in sync with key strokes, ripples spread around a pressed key, and objects are shot out. Thus, users can feel euphoric while typing. Additionally, users are more immersed when typing is imparted with sound effects while watching their favorite view such as Sci-Fi-like sound and get healing with the crying of animals.

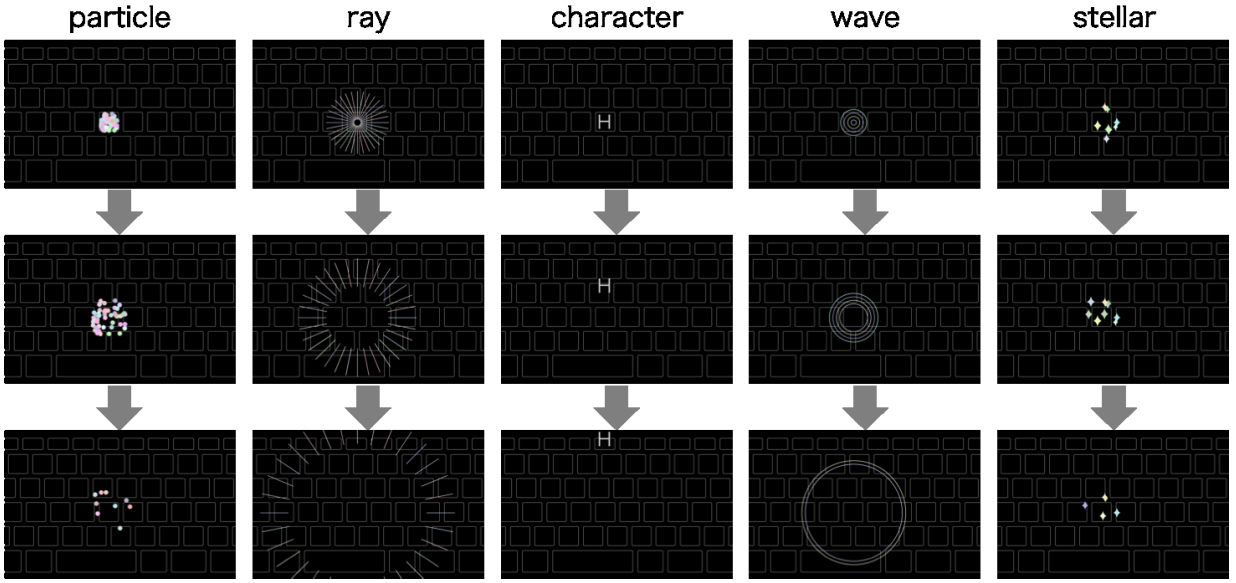

Figure 2: Five visual effects.

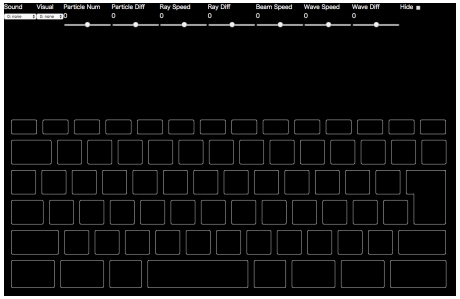

Figure 3: Production system implemented as a web page.

IMPLEMENTATION

Visual Effect

In augmented typing, the visual effect is displayed around a pressed key. The implementation of our augmented typing system has five visual effects: particle scatter (particle), radial rays (ray), launching characters (character), wave spread (wave), and shining like stellar (stellar). Figure 2 shows each of these visual effects. Generally, only a key frame is displayed followed by the effect when a key is pressed. Each effect is displayed with whitish random colors to make it conspicuous in projection.

Sound Effect

Herein, the system produces the sound effect with depression of a key. The implementation of our system has six sound effects: typing sound of the keyboard (keyboard), typing sound of the typewriter (typewriter), bass digital sound (digital1), treble digital sound (digital 2), Japanese drum (wadaiko), and meow of a cat (cat). Furthermore, sound sources distributed were used as free resources.

[1]https://github.com/yumu19/augmentedtyping

[2]https://yumu19.github.io/augmentedtyping/

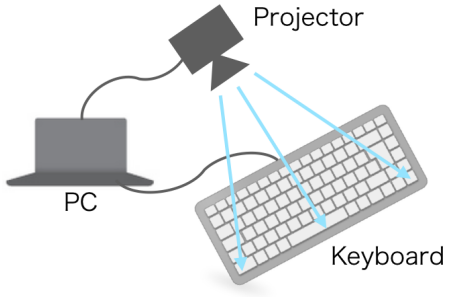

Figure 4: Hardware configuration of the system

Figure 5: Photo of the system

Software

We implemented a system that renders visual effects and plays sound according to a key press as a web page in JavaScript, which has two advantages: it runs on any browser without a specific environment such as OS and software and it can be accessed via the internet if it is published on a web server. We have published the source code of the implemented software on GitHub[1] and it is accessible as an Web site[2].

Furthermore, we used the JavaScript library p5.js to describe the visual effects. Notably, p5.js is a library that can be described using the same notation as processing, and it is suitable for describing visual effects to simplify the drawing of graphics. Key presses can be hooked by calling the *keyPressed()* function of p5.js. We set the frame rate of visual effect to 30 fps.

In addition to an area that draws the effects, we placed a control panel at the top of the page (Figure 3). The control panel comprises parts of HTML form and can be operated with a keyboard and mouse. Using the control panel, users can select visual and sound effects and adjust some parameters with a slider.

Hardware

We have constructed hardware for realizing Augmented Typing using the system software proposed herein. A projector connected to a laptop PC projects a visual effect directly above a physical keyboard (Figure 4, 5). The projector is fixed to a tripod, and the keyboard is connected to the PC via a USB. The sound effect is played from the PC. The keyboard used was *Apple Keyboard with Numeric Keypad*, the PC was *MacBook Pro Retina*, and the projector was *Dell M110* with 300 ANSI lumens brightness, and 1280×720 resolution.

EVALUATION

Experiment Summary

To clarify the influence of effect assignment on typing, we conducted an impression evaluation experiment on the five visual effects and six sound effects discussed in the previous sections. With reference to Kawasaki and Ideguchi[9], we chose the following seven impressions: *powerful*, *light (airy)*, *warm*, *annoying*, *beautiful*, *dynamic*, and *gaudy*. We performed the impression evaluation by semantic differential scale method, and each item was set to the 7-point Likert scale for each option. The experiment was conducted for eleven college and graduate students. To independently evaluate visual and sound effects, we conducted the experiments without sound when evaluating visual effects and vice versa.

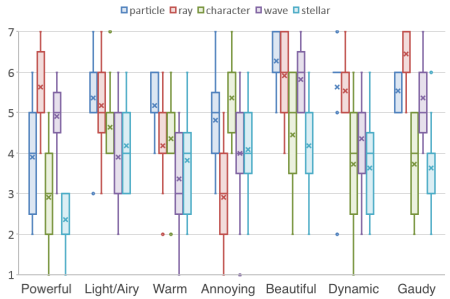

Figure 6: Result of impression evaluation of visual effects.

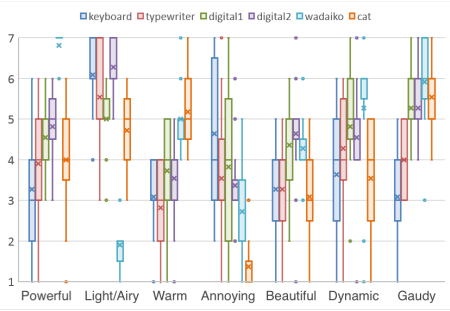

Figure 7: Result of impression evaluation of sound effects.

Result

The impression evaluation result of each of the effect is shown in Figures 6 and 7, where the variation of the impression is described in a box-and-whisker diagram. In the experiment, the variation of sound effect impression was observed to be larger than the visual. Moreover, for *annoying* and *beautiful*, which have superiority/inferiority, the score of visual effects is higher than sound.

A comparison of the impressions of each effect is shown in Figures 8 and 9. In these figures, the comparison of the impression is described in a radar chart. While the impression of the visual effect is roughly equalized, the impression of the sound effect tends to differ depending on the sound.

Impression to effect

In the evaluation, we gathered impressions to the visual effects and to the sound effects with free description. The answers were written in Japanese, but in this paper, we translated it into English. Descriptions in brackets indicate the type of effect.

Positive impressions for the visual were *"It was fun to fast typing at high speed and wide range (ray)"* and *"It was nice to be light (ray)"*. While, a negative impressions was *"If the range is too wide, other keys become difficult to see. (wave)"*.

Positive impressions for the sound were *"When such a sound comes to the virtual keyboard such as iPhone, it is good to have a feeling of typing (keyboard)"*, *"I get a feeling that work is progressing (keyboard)"*, and *"Feeling like using a PC of the future, it is fun. I feel like I am in a movie scene. (digital1)"*. While, a negative impressions was *"I do not feel like this sound comes out from the appearance and the UI of this keyboard. There was discomfort. (digital1)"*.

RELATED WORK

Interface Augmentation

Devices and systems for displaying visuals on a physical keyboard have been proposed in the past, and some are commercially available. *Optimus*[13] has an organic EL display embedded in the key top, and a user can change the language of characters and display any icon. Block *et al.*[2] presented an augmented keyboard that assigns special functions as keys using projection mapping. *Touch Bar*[1] was installed on the MacBook Pro from the 2016 model. Unlike existing keyboards and touch panel displays, *Touch Bar* has limited display and input function, and its functions changes based on a running application. These cases are aimed at improving the functionality, and are different from experiment augmentation targeted in this research. In addition, the range of visual effects in these cases remains above the device.

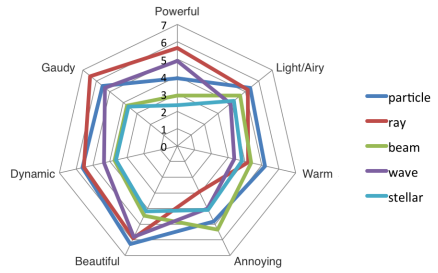

Figure 8: Comparison of impression evaluation of visual effects.

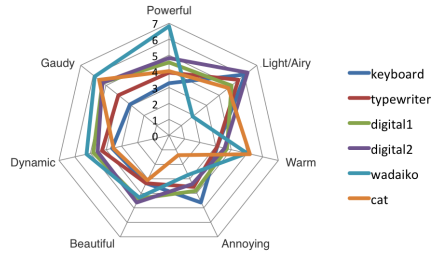

Figure 9: Comparison of impression evaluation of sound effect

Experience Augmentation

A projection mapping, which is used in the implementation of the prototype presented herein, is a method of projecting images on objects, which results in various effects. The projection mapping is often used not only as an entertainment for watching visual images but also as a technique for extending an experience. *Piano-as image media*[7] realized production methods, in which piano is played according to the image projected on the screen adjacent to the piano keyboard and the image changes according to the performance. Recently, a production method that uses an illusion, which appears stereoscopically from a specific viewpoint [4] was presented and studied. These are examples of experience augmentation other than typing.

Furthermore, typing experiences can be enhanced by incorporating images to the physical keyboard. *Magic Keyboard*[3] implemented launching characters according to keystrokes by projection mapping. *Visual IO*[5] implemented it in a virtual reality space. These cases don't use the projection mapping which is used in this paper.

FUTURE IMPACT

By choosing effects that match their preference and creating unique keyboard in the world, it is possible for users to achieve the desired satisfaction by using the system. In this paper, we implemented cool effects. But there are other possibilities to implement cute ones, healing ones and so on. It is also possible to publish configuration files as open sources and rearrange configuration files made by other people.

To realize the concept of augmented typing, it is necessary to provide a display function to keyboards, which are input-dedicated device. As described in the previous section, the prototype implemented herein for realizing augmented typing is based on the projection mapping method. As another method, a display may be mounted on a key top or a touch panel-type display may be used as a keyboard. Laptops equipped with variable e-ink keyboard, *Yoga Book*[11], are already in the market. There is also a method of realizing augmented typing that uses a transmissive head-mounted display such as *Microsoft HoloLens*[12], where only a user can experience effects without displaying anything in the real space.

AUTHORS

Tsubasa Yumura is a researcher in Japan Advanced Institute of Science and Technology (JAIST). His research interests revolve around Ubiquitous Computing and Cyber-Physical System.

Satoshi Nakamura is a professor in Department of Frontier Media Science, School of Interdisciplinary Mathematical Sciences, Meiji University. His research interests revolve around Search and Interaction, Spoiler Detection, Average Handwritten Character and BADUI.

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