

Study on Trends of NUI device and Applicability to UI of VJing system

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Abstract. The gesture recognition user interface is useful when the user is required to simultaneously control audio and video devices or the user needs to control video system by way of action while performing, for example, VJing which requires the user to control video in real performance. Based on how sensor is attached, the way to recognize gesture is categorized into direct-contact and non-contact type. While sensor is directly attached on human body in direct-contact type, sensor is operated maintaining some distance from human body in non-contact type. The preference for the types of devices will depend on several factors such as cost, operating environment and recognition performance. To determine suitable gesture recognition type for real-time performance environment like VJing, it is necessary to explore advantages and disadvantages for each method. In terms of gesture which will be used as command to instruct device, advantages and disadvantages should be investigated taking into account of the environment where the device will be used in order to design user interface (UI) most suitable for its purpose. This study aims to explore advantages and disadvantages for each type of device and suggest the elements of gesture that need to be considered if the gesture is desired to be used as command.

Keywords: NUI (Natural User Interface), gesture-based user interface and VJing performance

1 Introduction

As digital sensor technology has been advanced recently, study on the user interface (UI) controlling device or equipment by recognizing user's action has actively conducted as a part of natural user interface (NUI) area. Basically, this type of devices is designed to collect user's motion data from sensor and identifies command by analyzing pattern and matching the pattern with the predefined command set. Based on how sensor works, the devices can be categorized into two types: contact and non-contact type. Contact type device uses contact-type sensor which recognizes user's motion by

way of being attached on the surface of human body to recognize the motion of muscle and to detect a change in gravity according to the change in device's posture. Unlike contact type device, non-contact type recognizes the motion from a distance generally by recognizing visual information.

On the other side, evolution of digital video technology contributes to widespread of VJing which shows video performance and music at the same time. Due to widespread of VJing, user needs for fast and efficient control are increasing. Therefore the use of non-contact gesture-based UI will be significantly effective for VJing which requires to control performance video in real-time.

2 Current Status of Gesture-based User Interface Device

The gesture-based UI which aims at providing more natural and convenient interaction with device is categorized into two types: contact and non-contact types. In case of contact type of UI, the strength is that it can deliver the command accurately, while the weakness is that the device is too expensive and requires additional ancillary device. In case of non-contact type of UI, the strength is that it allows user to move more freely with no need of ancillary device required, while the detection to the motion might not be accurate. For these reasons, in the first stage, non-contact type is considered to be more advantageous than contact-type. However, as devices get lighter and smaller and communication module connecting between two devices is developed, the advantage of contact-type considers to be more attractive. If a small-sized ring and a arm-band type device are attached on human body, and those contact-type devices sends data indicating user's motion in fast and accurate manner, the uncomfortableness caused by contact-type device might be reduced. Moreover, non-contact type device has limitation in extracting user's motion. When constructing gesture command using the data sent by non-contact type device, discriminability between commands should be taken considerable care. On the contrary, contact-type device is capable of delivering signal more accurately. Therefore, even if discrimination between commands is not that enough, probability of erroneous recognition becomes relatively less than non-contact type.

Looking at the trends of devices developed with a goal to commercialize, it started from the glove type covering up user's entire hand and evolved to the ring-type worn in one or more fingers or the band-type worn in a wrist. More recently, the study on a wearable type of device is moving toward more convenient form like a film-type device which can be attached on the skin. Since the attachable type of device is easy to carry and control, such a wearable type of device is preferred more. The wearable type of device has tendency to evolve to a form of attaching on a part of human body rather than covering whole body or a part of body, in order not to occupy too much volume or not to place too much weight to the user. For example, write-watch type of device is designed to detect movement of hand placed on top of watch using infrared proximity sensor and array. According to the experiment with ten subjects who are supposed to use the watch-type device while moving and staying still, the watch-type device achieves 95.5% of recognition rate in both indoor and outdoor environment. Basically the watch-type device is operated in a very similar mechanism with the Leap Motion.

But it has advantage over the Leap Motion in that it has better mobility and better accuracy in recognition by enabling to detect user's gesture in proximity of user. These trends of devices are strongly based on the technology advancement by which device can be smaller and lighter than before, which contributes to production of the wearable device with less volume and less weight felt by user. Apart from the improved mobility, another advantage coming from the wearable device is that the probability of error occurrence can be reduced because it detects user's gesture in proximity of user. For these reason, the wearable type of device has developed recently. However, there are some issues to be resolved to successfully commercialize the type of device such as what gestures are suitable for being used as command and as what environment the type of device is more suitable.

Type	How to use	Advantage	Disadvantage	Examples	Information to use
Non-contact	Use by visual information	Natural motion is extracted	Difficult to extract characteristics	Kinect	Movement of entire body
				Leap Motion	Movement of fingers
Contact	Use by attaching on human body	Accurate information is extracted	High-cost of equipment	Muscle-type	Change of muscle
				Gravity-type	Change in gravity and acceleration

Fig. 1. Types and characteristics of gesture-based devices

3 Application Environment of Gesture-based User Interface

VJing is a manipulation and mixing visual images with audio in live performance and VJing tools are also similar to general editing tools. Recently, a number of commercialized software tools suitable for VJing are on the market. Some tools are designed to easily link with external effects using programming language in conjunction with sensors to provide interactive visual effects. Therefore the developments of those tools are closely related to recent trend of requiring more active and more creative visual effects. There are a variety of commercialized software tools used for VJing, for example, Resolume, Module8 and VDMX to control visual effect in realtime.

Particularly, 'Resolume' is a significantly efficient tool since it can integrate with Processing and VVVV to provide real-time interaction effect as well as integrate with various audio and communication devices such as MIDI and OSC. 'Module8' is suitable for basic function of VJing like realtime video transition and also a variety functions such as RGB color transition, video scale transition and axial transition of video. Most popular VJing tool, 'VDMX' enables users to readily and easily mix more than one videos in a screen with multiple windows showing those videos at the same time.

To evaluate usability of gesture recognition interface which is considered to be intuitive and effective for VJing, we referred to the study on usability comparison of gesture interface and mouse based on Fitt's Law test (Yun-Gun Jung, 2013). Fitts' Law test is a certified testing tool to evaluate moving and clicking the cursor on computer. Fitt's Law test sets difficulty to 96 levels with three factors: distance (D), width (W) and angle (A) between cursor and a target. For each level, it measures the response time of two cursors whose locations are randomly selected. The mission of the level is considered to be accomplished if the user clicks the target by moving cursor successfully. Test results indicate that gesture recognition interface does not show usability problem in the contents in which the size of menu is large and accuracy does not matter like game. On the contrary, mouse shows better performance in general interface environment that requires more accurate interaction.

In real performance, VJing requires speedy transition of visual images and accurate control. According to the test results, gesture interface shows underperformance in accuracy of controlling, while it is advantageous in controlling large-size menu. Therefore more study on simple and explicit gesture is essential for gesture interface suitable for VJing.

4 Suggestions for Effective User Interface

As discussed above, the traditional devices should be investigated and evaluated in terms of user environment of VJing for improving users's satisfaction. In particular, study on the gestures consisting of command should be conducted in order to use gesture as command for controlling device. There are several considerations to do this. First, discrimination between commands needs to be improved (discriminability between commands). Second, the commanding gesture and non-commanding gesture should be distinguished (discriminability between gestures). Third, the commanding gesture should be simple because the user might be in the middle of controlling other devices by hand (physical easiness). Fourth, the gestures should be cognitively easy (cognitive easiness). Addition to these, the devices should be developed in a way of reflecting the detection of user's motion promptly and exactly based on the analysis of the gestures.

In developing new device, considerations to be taken into account are as follows. Usability evaluation for device should be fulfilled by taking both of bottom-up and top-down approaches. Bottom-up approach is to find a special symbol and meaningful action starting from the user's natural and general uses. Top-down approach is to set a specific gesture and apply it to user by investigating user's environment, linking it with the device's purpose and considering proper metaphor. Though bottom-up approach requires considerably extensive data collection and analysis, it could often find out gesture command by luck. On the contrary, top-down approach could incur negative effect such that it forces the user to do unnatural action without careful investigation about the characteristics of equipment to use. Therefore it is essential to understand the characteristics of usage environment and equipment prior to using it.

5 Conclusions

In an environment like VJing in which one person needs to control visual image editing system together with mixing music at the same time, it will be useful to utilize NUI-type user interface which can recognize user's natural action as command. Gesture-based user interface can be implemented by two ways: visual information based non-contact type device and contact-type device such as ring or wrist band. Though such NUI-type user interface might have various limitations and drawbacks, the advancement in digital technology and recognition device such as sensor contributes to building an efficient environment in which gesture can be used as command easily. Compared to the advancement of hardware capability, there have been relatively not enough studies on how to construct command set more efficiently so far. Therefore, more studies focusing on how to construct gesture command with improved discriminability and usability are necessary through investigating usage environment and conducting user test. Particularly, the working environment of VJing is highly noisy and the user needs to control visual image together with doing music mixing with large-sized action for performance. In this environment, user interface should be quick and prompt in responding and be efficient in accepting gesture as command. Based on the studies on user interface and technical advancement of devices, there are four factors that are necessary to consider when developing more efficient gesture-based user interface as follows: 1) discriminability between commands, 2) discriminability between gesture, 3) user's physical easiness, and 4) user's cognitive easiness. When developing NUI-based user interface using gesture, these four factors and user convenience should be taken into account. If analysis and investigation are carried out based on these factors, the results will give good insights in developing suitable devices and constructing a gesture set so that it could contribute to provide efficient user interface for an environment where fast, accurate and immediate control is required.

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