# Hands-free Gesture Operation for Maintenance Work using Finger-mounted Acceleration Sensor

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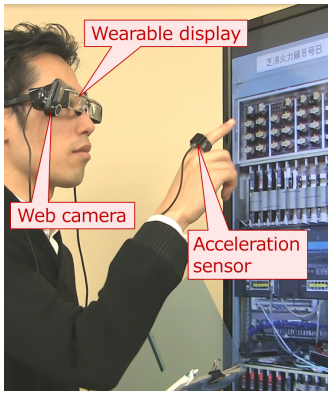


**Figure 1:** *Demonstration system.*

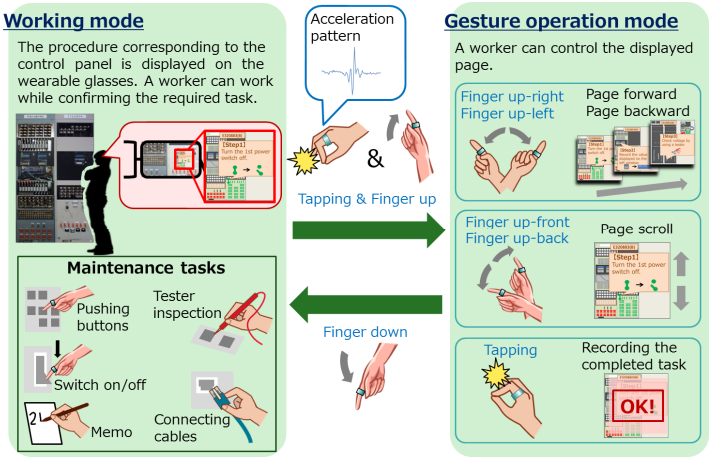


**Figure 2:** *Process of maintenance and inspection work using our system.*

## 1 Introduction

In maintenance of electric power control panels, a worker has to do a lot of manual work such as pushing buttons and turning on/off selector switches. Therefore, a hands-free gesture operating system is needed. Tsukada [Tsukada et al. 2002] proposed a gesture operating system using an acceleration sensor and switches. Although it is a simple task to control a home appliance by gesture, users have to use both gesture and switch on/off to perform more complicated tasks such as controlling and recording documents in maintenance work. Therefore, the system becomes complicated. We propose a novel switch-less assist system for maintenance work with a simple structure that recognizes gesture using only an acceleration sensor. Ike [Ike et al. 2014] proposed a hand gesture operating system that enables users to control a TV remotely by adopting "Tapping" as a click signal. The system recognizes tapping by detecting a pulse-like acceleration pattern corresponding to a micro collision generated by tapping. However, it is difficult to recognize tapping because maintenance work includes many micro collisions generated by touching things. We adopt "Tapping & Finger up", i.e., tapping fingers and turning up a finger, gestures that rarely occur in maintenance work, and design a gesture system enabling users to perform maintenance tasks and gesture operation seamlessly. Our system helps users do maintenance work easily and intuitively without interrupting work.

## 2 Acceleration-based Switch-less System

Fig.2 shows the process of maintenance work using our system.

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A worker wearing a glasses-like display looks at a control panel. Then the corresponding operation procedure is displayed on the glasses. The worker can work correctly by confirming a required task described there (in "Working mode"). Upon completing the task, by "Tapping & Finger up" he changes from the current mode to "Gesture operation mode", in which the procedure can be controlled by gesture. In this mode, changing the displayed page by forward/backward, scrolling the page, recording the completed task and returning to Working mode are realized by "Finger up-right/up-left", "Finger up-front/up-back", "Tapping" and "Finger down" respectively, which can be recognized by acceleration.

## 3 Prototyping and Results

Fig.1 shows our prototype system. A worker wears a ring-like 3-axis acceleration sensor and a glasses-like display with a camera. An OCR recognizes the control panel's ID from an image captured by the camera. The angles of the user's finger (of the right-left axis and the front-back axis) are calculated by 3-axis acceleration, regarding the direction of their composite vector as that of gravity. Tapping recognition is realized by the method shown in [Ike et al. 2014]. We had 10 users control procedures by 3 gesture tasks, namely, changing mode, changing displayed page and returning to Working mode, and then complete a maintenance task described in the displayed page. We had them perform the 5 maintenance tasks shown in Fig.2 in a sequence and do them 3 times. The harmonic mean between gesture task recognition precision and recall was 95.9%. The result shows that our system recognizes users' operation accurately in maintenance work.

## References

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Ike, T., Nakasu, T. and Yamauchi, Y. 2014. Contents-aware gesture interaction using wearable motion sensor. In *Proceedings of ISWC 2014,* vol. 2, 5–8.