IEEE GCCE 2018 にて研究発表

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1. Preface

I participated in IEEE GCCE 2018 held at the Nara Royal Hotel from 9th to 12th October 2018 and made a poster presentation on the theme of “Operation Method for Display Screen Using Acceleration Sensors on a Fingertip”.

2. Presentation content

2.1 Abstract

This paper describes a new method of operating display screens. The authors propose a method of operating the display screen by detecting the movement of acceleration sensors attached to a fingertip.

In experiments, the acceleration of linear movement and rotary movement in three axial directions was detected, and the screen was operated following these movements.

As a result, we verified that this proposal is valid.

2.2 Introduction

On some modern display devices, such as digital signage and electronic books, the user can operate the display screen.

The operation methods include a touch panel on the display operated by directly touching it, methods that use cameras and infrared sensors to detect the user’s movements, and methods that use terminals or watch type wristbands equipped with acceleration sensors.

However, these methods have the following types of problem: (a) the operation range in which the user can directly touch the display screen is limited, (b) the device must be placed in an environment that is sufficiently bright and has a simple background, and (c) the device must be hand held or mounted on an arm.

Because of these reasons, it cannot be said that these display device operation methods are sufficient.

The authors propose a new remote operation method for display devices for solving these problems in this paper.

2.3 Study outline

A compact device with acceleration sensors is placed on the user’s fingertip to detect the fingertip movement.

The proposed system is configured of a compact device with an acceleration system and the display screen to be operated as shown in Fig. 1.

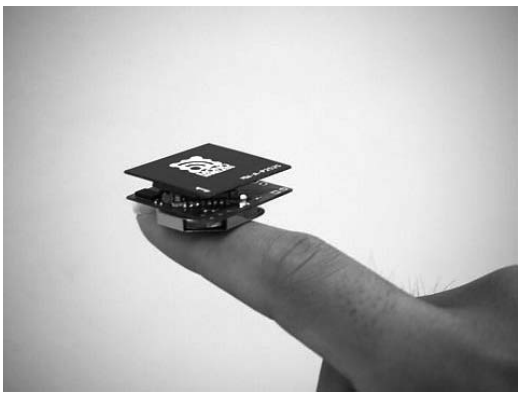

Fig. 1　Acceleration sensor on a user fingertip

The user can perform various display screen operations through linear movement and rotary movement in three axial directions achieved by moving the fingertip up/down, left/right, and forward/backward and rotate. The device is connected with wireless communication assuming the user and display device will be separated.

The evaluation system shown in Fig. 2 was prepared to evaluate the proposed details. A TWILITE by MONOWIRELESS was used for the acceleration sensors and wireless module. This device has 3-axis acceleration sensors and a 2.4 GHz Wi-Fi module. Each data unit has a 16-bit resolution. The 3-axis acceleration values

can each be obtained at a maximum 10-millisecond interval as the time interval Δt of Formula (1).

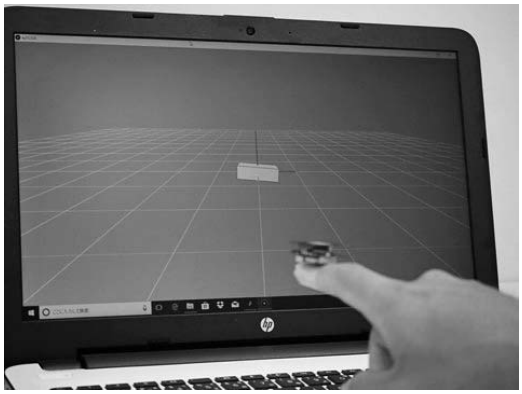

Fig. 2 Evaluation system

The acceleration sensors on the fingertip detect the 3 -axis acceleration for the x, y, and z axis. The linear movement and rotary movement are detected from this acceleration data as explained below.

For the linear movement, distance x is calculated and obtained with Formula (1). Movement distance x here is obtained with acceleration αx, detected from the acceleration sensors, which is integrated twice with the minimum time interval Δt. Distance y and z can be obtained in the same manner. Where m and n are integers.

$$d_x = \sum_n \left(\sum_m \alpha_{x,mn} \cdot \Delta t \right) \cdot \Delta t \qquad (1)$$

For the 3-axial direction rotary movement, angle θx was calculated with the following Formula (2). A θy and θz can be obtained in the same manner.

$$\theta_y = \arctan\left(\frac{\alpha_z}{\alpha_x}\right) \qquad (2)$$

Finally, when the screen operation is judged, the command corresponding to the result is used to control the operation target display device screen.

3. Results of using evaluation system

The results of the evaluations conducted by tilting a fingertip are given as an example.

Fig. 3 shows the relation of the detected acceleration and time. In the evaluation, the data from the acceleration sensors was retrieved with 0.1 second as the time interval Δt of Equation (1). The first 1 second and last 1 second were a stationary state.

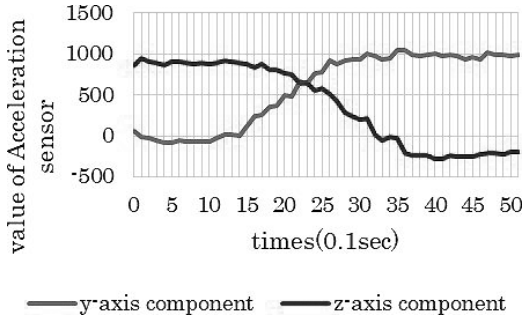

Fig. 3 y element and z element data

4. Conclusion

A method of operating the display screen by detecting the movement of acceleration sensors attached to on a fingertip is proposed. In the evaluations, the acceleration of linear movement and rotary movement in 3-axial directions was detected, and the screen was operated following these acceleration. As a result, it was verified that this proposal is valid.