Software Development for Physically handicapped child using gaze camera

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I. OBJECT

At present, a mouse, a keyboard, a touch panel, and the like are generally used as inputs of a computer. However it might be difficult to use these input devices in the case of physically handicapped child. In this study, we developed software that can be operated by physically disabled children using Gaze-camera. We developed a bowling game that the participant likes. Therefore, the goal of this study is to control the ball of boring by using Gaze camera.

In addition, when developing a game, it is necessary for user to use the game and to feedback the results to make improvements. This was only one time, but there was an opportunity for such verification, so we will report it together.

II. OVERVIEW

A. Gaze camera

Gaze shows a small change in the person's interests, goals, thoughts, or feelings. The gaze contains a lot of information, and the camera that detects the position of the gaze is called gaze camera. The gaze camera uses the position on the cornea of the reflected light produced by illuminating the infrared LED as a reference point, and detects the gaze based on the position of the pupil relative to the reflected light(corneal reflection). [1] In order to use a gaze camera, a process called calibration is required that measures the characteristics of the subject's eyes and calculates the viewpoint using a customized anatomical 3D eye model based on it. [2] The cameras are used in various fields such as research, marketing and input devices.

B. System overview

Children using software can not move their limbs freely. Therefore, we developed various input devices such as gaze camera, touch panel, head movement sensor, and decided them for education. We were in charge of software development using gaze camera. We used Tobii Eye Tracker 4C Gaming Peripheral [3] as gaze camera and Unity 5.3.7 [4] as development environment, and developed game using Tobii Unity SDK [5] for Desktop as API for gaze camera. In addition, since this API can detect head position other than eyes, it was possible to select both.

C. Specification

1) Version1 Specification: Figure 1 shows state tradition diagram of version1, and Table I shows operation method. In version1, we wanted kids to play games just like they would in a real bowling alley, so we avoided the icons as much as possible. Therefore, immediately after game starts, the main state is set and operation of table 1 can be performed. Here, for example, the operation of the throwing position of the ball is operated by face turning. In the throwing screen, when attention is paid to the arrow, the screen transitions to the main screen and throwing is started. After 10 frames, the total score is displayed.
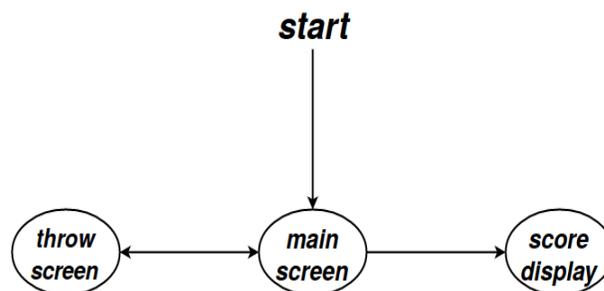

Fig. 1. version1 state tradition diagram

TABLE I
OPERATE METHOD OF VERSION 1

in game operation	operate method
movement of throwing position	operation with face turning
determine of throwing position	gaze the ball
determine of throwing direction	gaze the arrow

2) Version2 Specification: Figure 2 shows state tradition diagram of version 2, and Table II shows operation method. In version2, we thought that it was necessary to be able to select the operation method according to the progress of the symptoms of the physically handicapped child, and we made it possible to select the operation method from the gaze and the head. When the operation method is selected, the main screen is displayed, and the operations in Table 2 can be

performed using selected operation method. Here, for example, the operation of the throwing position and direction of the ball are operated by looking at the arrow in the case of the gaze, and by turning face in the case of head position. When the throwing direction is determined, the main screen is displayed and throwing is started. After 10 frames, the total score is displayed. At the time of operation verification, the only way to confirm the operation was to change the color, so it was very difficult to know how to operate the ball. So we added an arrow icon to improve the UI.
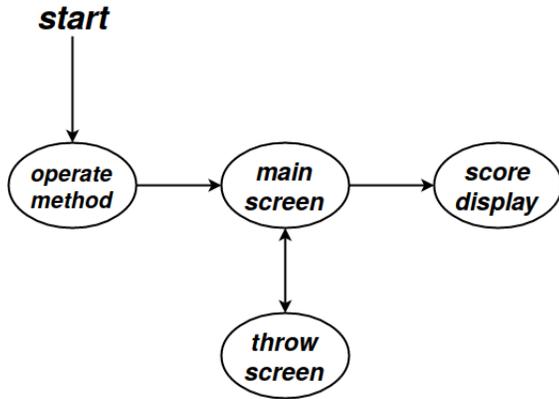

Fig. 2. version2 state tradition diagram

TABLE II
OPERATE METHOD OF VERSION 2

in game operation		operate method
movement of throwing position	head	face turning
	gaze	gaze the ball
determine of throwing position	head	nod
	gaze	gaze the ball
determine of throwing direction	head	face turning (left and right) face up(straight)
	gaze	gaze the ball

D. Flow of the game

The flow of the game in the version 2 will be explained. When the game is started, the selection screen of operation method is displayed. The operation method is selected from two types: head or gaze. When operation method is selected, the main screen is disabled. In the main screen, the position of the ball is determined first. When the pitching position is determined, the screen is transitioned to the throwing screen. When the throwing direction is determined, the main screen is displayed. When returning to the main screen, throwing is started, then pins are knocked down, and the number of the knocked-down pins and the score are displayed in the score table. After repeating this operation, and at the end of the game, the screen is changed to the score display screen at last and the final score is displayed.

E. Verification

On February 30, 2019, we brought the developed system to Kurume city Kurume special support school and had child actually experience it, and verified the operation. In September 2018 when we started to plan for the software development, we were planning to use the software installed desktop PC on and have the child operate it sitting on a chair. However, the child's condition deteriorated and it was decided to operate while lying on the bed. But the operation posture was not supposed, and we could not successfully get gaze data. The problems found in the verification at the special support school are shown below.

    a. The gaze data could not be got by change of operation posture

    b. It is difficult to understand how to operate.

We discussed improvement points in the previous chapter, so please refer to that.

III. CONCLUSION

In this study, we could operate throw position and direction of the ball with two kinds of operations: eyes and head. For the development of input equipment and software for physically handicapped children, the operation method suitable for individual symptoms is necessary Since it is difficult to develop for every symptom, it is necessary to increase operation method as much as possible and select from them. This time, we have developed a game application, and we think it will be necessary to develop software in which the physically handicapped child can operate people physically handicapped children to work in the same way as healthy. In addition, since the improved game has not been experienced by children we would like to bring it to special support school again.

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