Enhancing Interaction Capability for VR Handheld Controllers: Exploratory Approaches using Swept Frequency Capacitive Sensing and Vision Sensing in Real-time

VRコントローラのためのインタラクション機能の拡張：広範囲の周波数帯での静電容量センシングとビジョンセンシングを考究したリアルタイムでの手法の提案

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While current commercial VR handheld controllers provide interaction for users based on the design of the controller with limited buttons, joysticks, and capacitive sensors, this work seeks to provide additional inputs using other sensing technologies. This paper present two new approaches to enhance interaction possibility for VR controllers. Both of them use real-time finger gesture sensing methods: (i) a touch sensor using circuits of swept frequency capacitive (SFC) sensing, (ii) a near infrared (NIR) camera sensor applied with vision-based Convolutional Neural Network (CNN). Based on the two methods, prototypes are designed to enable the gesture recognition for HTC Vive controller. This study explores these methods separately by attaching the SFC sensing circuits and a near infrared (NIR) camera onto the controller. In the systems, the SFC sensor is used to obtain touch information, while the NIR camera modified from a webcam is used to recognize discretized positions of individual fingers. An initial combination of the two sensing components is also explored by enabling a state machine utilizing the output of these two sensors. For the application scenarios, the thumb postures in air recognized from the camera sensor are expected to control the movement of objects in VR, and the discrete finger gesture input from the two sensors can be used to perform a simulation of hand pose recovery. The feasibility is demonstrated by two Unity demos in real-time. In the evaluation, this study reports accuracy and real-time performance for this work's approaches.

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