Upper-Body Posture Estimation Employing both Palm and Back of the User's Hand-Mounted Cameras

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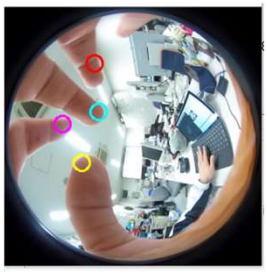
Introduction

We propose a posture-estimation method that employs wearable devices. By attaching fisheye cameras to the palms and backs of both hands, the system captures the surrounding environment in all directions. The implementation of these features enables the simple and comfortable tracking of fingertip and upper-body motions that can be reflected in a virtual space. Our proposed system employs fisheye cameras attached to the user's hands to capture 360° videos of each hand and estimate the position and posture of the head and fingers without restricting the posture of the upper half of the body.

System Implementation

Finger Posture Tracking



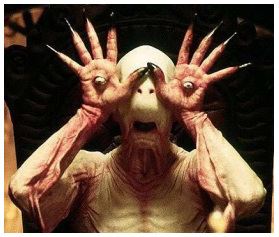
Maruyama and Kono proposed a method for estimating the natural finger postures of a user's fingers by detecting the fingertips on each fish-eye image captured using an omnidirectional camera attached to the center of a user's palm [1]. They also developed an AR pottery wheel-throwing system employing an HMD and omnidirectional cameras, each of which was attached to the center of the user's palms [2]. The omnidirectional cameras enable the estimation of the user's finger postures and the three-dimensional relative position and orientation between the user's hands and the virtual clay model on the wheel. The finger posture is estimated using these methods.

Head Position and Posture Tracking

The upper-body posture estimation method in this research requires users to wear camera devices attached to both the palms and backs of their hands, and the blind spots of the camera on the back of each hand can be compensated for by the camera on the palm. This research employes both the histogram gradient of the face area and the distance between the human eyes to estimate the position and posture of the head. The head posture was determined by analyzing the facial features in the histogram of the face region. The distance from the camera to the head is calculated by consulting the average interocular distance (PD), which is 64±5mm for an adult.

Results and Future Directions

The experimental results involving seven subjects showed that the proposed method is more effective than the existing ones under certain conditions. The appearance of the prototype is somewhat unrealistic because it employs "commercial" devices. We believe that the appearance is significantly realistic when the devices are embedded in the skin. Creatures or monsters that have an eye on each parm have frequently appeared in legends or literature.



References
[1] Y. Maruyama and Y. Kono. 2018. Estimating Finger Postures by Attaching an Omnidirectional Camera to a User's Palm. In *International Conference on Advanced Visual Interfaces 2018 (AVI'18), Article No.72, May 29-June 1, 2018, Castiglione della Pescaia, Italy*. ACM New York, NY, USA, 3pages. https://doi.org/10.1145/3206505.3206560

[2] Y. Maruyama and Y. Kono. 2019. AR Pottery Wheel-Throwing by Attaching Omnidirectional Cameras to the Center of a User's Palms. In *AH2019: The 10th Augmented Human International Conference, Article No.47, March 11-12, 2019, Reims, France*. ACM, New York, NY, USA, 3pages. https://doi.org/10.1145/3311823.3311856