HandPoseMenu: Hand Posture-Based Virtual Menus for Changing Interaction Mode in 3D space

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Introduction

- A system control technique is needed to provide various spatial interaction techniques for VR/AR/MR applications.
- **We propose HandPoseMenu, hand posture-based virtual menus in 3D space:**
- Recognizing the non-dominant hand's posture using the depth sensor attached to the wearable display (Fig 1(a)).
- Presenting the virtual menus corresponding to the hand posture beside the non-dominant hand (Fig 1(b)).
- When the user selects a desired function among the presented menu as a dominant hand, the interaction mode is changed.

Figure 1:
(a) Example usage of HandPoseMenu (b) Various menus can be presented according to the hand posture

HandPoseMenu

Implementation

- HMD (Oculus Rift DK2)
 - ✓ 960 x 1080 per eye at a 75Hz, 100° FOV
 - ✓ VR environment
- Stereo Camera (Ovrvision Pro)
 - ✓ 960 x 950 per eye at a 60Hz, 99° FOV
 - ✓ MR environment
- Depth Sensor (Leap Motion)
 - ✓ Hand tracking
 - ✓ Gesture (and Posture) recognition

Figure 2: Implementation of HandPoseMenu

Hand Posture Recognition

- Data Collection
 - Collect the data by placing the Leap Motion on the desk in order to easily acquire 3D skeleton data based on the top center of the sensor.
 - 120000 data frames (6 people x 16 hand postures x 5 times x 5 seconds x 50Hz)
- Feature Extraction
 - The distances between the fingertips and palm center (5)
 - The distances of the fingertips from the plane corresponding to the palm region (5)
 - The distances between fingertips (4)
 - The angles corresponding to the orientation of the fingertips with respect to the hand orientation (5)
 - The angles between adjacent fingertips (10)

- SVM Classifier
 - 1 vs 1 multi-class classification (16 hand postures)
 - A 6-fold cross validation showed a mean accuracy rate of 94.49%

Controlling Graphical Menu

- Trigger
 - The angle between the vertical vector at the top of the Leap Motion and the normal vector of the back of the hand is within 45 degrees.
- Real time classification based on SVM model
 - Virtual menus corresponding to hand postures can be displayed.
- Changing the interaction mode
 - Select the target menu with a dominant hand.

Figure 3: Set of candidate non-dominant hand postures

Application

Figure 4: (a) 3D drawing task in VR (b) Select the thickest pen (changing the interaction mode) (c) Perform the 3D drawing task with the thickest pen (d) 3D drawing task in MR

Figure 5: An example of HandPoseMenu in 3D modeling and drawing (a) P1: activate/deactivate the interaction mode (dominant hand) (b) P2: create a 3d model (c) P3: thickness of the pen (d) P4: color of the pen (e) P5: material of the pen (f) P6: delete the 3D objects or drawing contents

Conclusion and Future Work

- **A hand posture-based graphical menus system**
- **The user can control the virtual menus using hand postures corresponding to the purpose of the main task, and can change the interaction mode.**

- We will compare the usability of our proposed method, which combines a graphical menu and hand posture, with the existing system control methods (only graphical menu or only hand posture).