

Ideation Phase
Literature Survey

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Team ID	PNT2022TMID34850
Project Name	A Gesture-based Tool for Sterile Browsing of Radiology Images

1. The recently developed depth sensors, e.g., the Kinect sensor, have provided new opportunities for human-computer interaction (HCI). Although great progress has been made by leveraging the Kinect sensor, e.g., in human body tracking, face recognition and human action recognition, robust hand gesture recognition remains an open problem. Compared to the entire human body, the hand is a smaller object with more complex articulations and more easily affected by segmentation errors. It is thus a very challenging problem to recognize hand gestures. This paper focuses on building a robust part-based hand gesture recognition system using Kinect sensor. To handle the noisy hand shapes obtained from the Kinect sensor, we propose a novel distance metric, Finger-Earth Mover's Distance (FEMD), to measure the dissimilarity between hand shapes. As it only matches the finger parts while not the whole hand, it can better distinguish the hand gestures of slight differences. The extensive experiments demonstrate that our hand gesture recognition system is accurate (a 93.2% mean accuracy on a challenging 10-gesture dataset), efficient (average 0.0750 s per frame), robust to hand articulations, distortions and orientation or scale changes, and can work in uncontrolled environments (cluttered backgrounds and lighting conditions). The superiority of our system is further demonstrated in two real-life HCI applications.
2. In this paper, we address natural human-robot interaction (HRI) in a smart assisted living (SAIL) system for the elderly and the disabled. Two common HRI problems are studied: hand gesture recognition and daily activity recognition. For hand gesture recognition, we implemented a neural network for gesture spotting and a hierarchical hidden Markov model for context-based recognition. For daily activity recognition, a multi sensor fusion scheme is developed to process motion data collected from the foot and the waist of a human subject. Experiments using a prototype wearable sensor system show the effectiveness and accuracy of our algorithms.
3. The use of doctor-computer interaction devices in the operation room (OR) requires new modalities that support medical imaging manipulation while allowing doctors' hands to remain sterile, supporting their focus of attention, and providing fast response times. This paper presents "*Gestix*," a vision-based hand gesture capture and recognition system that interprets in real-time the user's gestures for navigation and manipulation of images in an electronic medical record (EMR) database. Navigation and other gestures are translated to commands based on their temporal trajectories, through video capture. "*Gestix*" was tested during a brain biopsy procedure. In the in vivo experiment, this interface prevented the surgeon's focus shift and change of location while achieving a rapid intuitive reaction and easy interaction. Data from two usability tests provide insights and implications regarding human-computer interaction based on nonverbal conversational modalities.
4. They have developed a system that uses computer vision to replace standard computer mouse functions with hand gestures. The system is designed to enable non-contact human-computer interaction (HCI), so that surgeons will be able to make more effective use of computers during

surgery. In this paper, They begin by discussing the need for non-contact computer interfaces in the operating room. They then describe the design of our non-contact mouse system, focusing on the techniques used for hand detection, tracking, and gesture recognition. Finally, They present preliminary results from testing and planned future work.

5. A gesture interface is developed for users, such as doctors/surgeons, to browse medical images in a sterile medical environment. A vision-based gesture capture system interprets user's gestures in real-time to manipulate objects in an image visualization environment. A color distribution model of the gamut of colors of the users hand or glove is built at the start of each session resulting in an independent system. The gesture system relies on real-time robust tracking of the user's hand based on a color-motion fusion model, in which the relative weight applied to the motion and color cues are adaptively determined according to the state of the system. Dynamic navigation gestures are translated to commands based on their relative positions on the screen. A state machine switches between other gestures such as zoom and rotate, as well as a sleep state. Performance evaluation included gesture recognition accuracy, task learning, and rotation accuracy. Fast task learning rates were found with convergence after ten trials. A beta test of a system prototype was conducted during a live brain biopsy operation, where neurosurgeons were able to browse through MRI images of the patient's brain using the sterile hand gesture interface. The surgeons indicated the system was easy to use and fast with high overall satisfaction.

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