# EnhancedDesk and EnhancedWall: Augmented Desk and Wall Interfaces with Real-Time Tracking of User's Motion

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## 1 Background and Motivation

In the last several years, we have been studying man-machine interaction by using computer vision and augmented reality technologies [1-8]. Our augmented desk/table interface system provides novel man-machine interfaces based on direct manipulation of both real and projected objects with our own hands and fingers. The key technical innovations of our system include fast and accurate tracking of multiple hands and fingers, interactive object registration and recognition with hand gestures, and overlay of interactive functionality. We also developed an interactive wall display using face-tracking system. Tracking the face of a user who looks at various parts of the screen would be a fundamental tool for a variety of perceptual user interface applications in ubiquitous computing environments that have many large displays in various spaces.

In our augmented desk/table interface systems, computer vision techniques play important roles for understanding user's activities, e.g., what the user is doing on a desk or where the user is looking at. While we have successfully developed new computer vision techniques for tracking human body motion and gesture recognition, a more fundamental question still remains: what kind of motion we need to measure, and what is the set of basic gestures needed for applications in augmented desk/table interface systems if such thing exists. Clearly, this should depend on each application, and probably there is not such thing like a set of basic gestures for a general purpose. Nevertheless we would like to discuss with other researchers about this question, and hopefully get some insight for further researches at the end of this workshop.

## 2 EnhancedDesk

Experiments with tangible objects, interaction with computer simulations, electronic-media databases and paper-based materials are common tools for wide varieties of tasks in offices and classrooms. This richness of semi-connected contents leaves us

with the burden of media synchronization. For example, the overhead of accessing a computer simulation mentioned in a printed book will often disrupt the trend of thought. A simple dictionary search on the web while reading a book entails the execution of a series of operations that cause shift in our focus of attention.

Our augmented desk interface system, called "EnhancedDesk," provides novel man-machine interfaces based on direct manipulation of both real and projected objects with our own hands and fingers. The key technical innovations of the EnhancedDesk include fast and accurate tracking of multiple hands and fingers, interactive object registration and recognition with hand gestures, and overlay of interactive functionality.

Once the augmented desk interface system proposed in this project is put to practical use, it will revolutionize the way people use a computer in every aspect of their daily lives. For instance, multimedia materials can be used more effectively for assisting students to study. An enormous amount of information available on the Internet would be used more easily in combination with physical objects such as paper documents. Moreover, the intuitive and interactive handling of computer applications in the EnhancedDesk will provide assistance to many people who would otherwise find it difficult to use a computer.

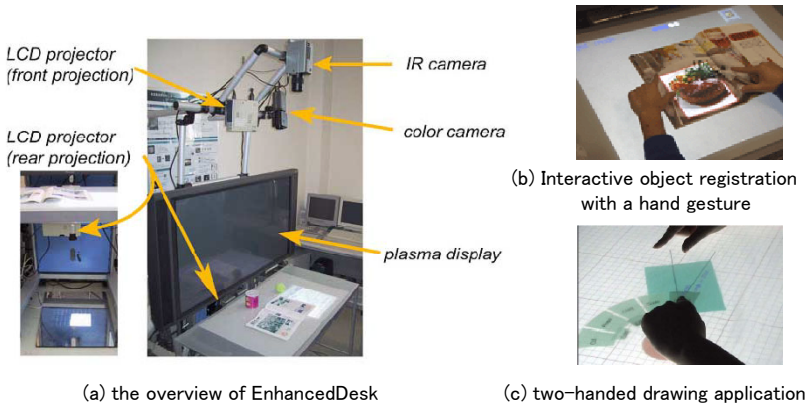


Figure 1. EnhancedDesk: an augmented desk interface utilizing image-processing technologies.

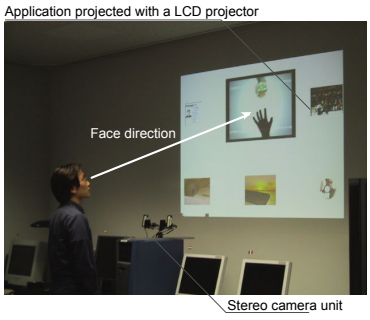


Figure 2. EnhancedWall: a wall-sized interactive display utilizing a face-tracking system.

## 3 EnhancedWall

Recently, large displays such as plasma displays or LCD projectors that can project images to a large area have become popular. They are often used in public places (e.g., stations, shopping malls or offices) for showing information. However, most of this type of information generally consists of pictures or movies, and it is only repeated and is not interactive, especially in public areas. Although the display equipped with a touch sensor will realize the human computer interaction, it needs the positive action of a user to do so. In ubiquitous computing environments that might contain many large displays, the perceptual user interface that shows information according to a natural activity of a user or to the situation of the place might be desirable.

In our interactive wall display, called "EnhancedWall", that utilizes a face-tracking system and the focus+context techniques, the gazed-at movie is magnified with the fish-eye view technique. It allows users to specify some information item of current interest, show the specified item in detail, and provide context by displaying the remaining items in successively less detail.

A face-tracking system would be able to give information to passive users or to those who happened to pass the display. Tracking faces of users who look at various parts of the screen would be a fundamental tool for a variety of perceptual user interface applications in ubiquitous computing environments.

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