

CESUE: A Cooking Education System in ubiHome Environment*

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Abstract. In this paper, we propose a cooking education system for the ubiHome environment (CESUE). Generally, web-based cooking education system runs without considering the user's learning state. Therefore, if a user misses the lecture, he/she must find the missed part using a time bar or other ways. With the help of rapidly deploying ubiquitous computing, the proposed CESUE can provide user-oriented multimedia cooking lectures by allowing the user to control each step interactively over the network. The proposed system consists of three key components; (i) vision-based interface, (ii) interaction for contents control, and (iii) visual and sound feedback. According to the scenario-based experiments, CESUE provides a more efficient cooking class than conventional text-based or web-based classes. The proposed system can be used as not only in the education system but also in various media applications.

1 Introduction

According to the rapid development of telecommunication and computer-related technology, users can access any information comprehensively. For example, a person can refer his/her stock quotations in real time by using his/her cellular phone or PDA. Such technologies also have affected the education environment.

Long distance education and training has been changing from distance learning (d-learning) to electronics learning (e-learning), even to mobile learning (m-learning) corresponding to the influence of social revolution [1]. For example, such developmental stages of the education environment coincide to the Industrial Revolution of the 18th and 19th century, the Electronics Revolution of the 1980s, and the Wireless Revolution of the late 20th century, respectively. Along with the trends, we expect a new trend, ubiquitous learning (u-learning) corresponding to the Ubiquitous Revolution of the 21st century.

Note that even m-learning is not enough to provide effective educational environments. Leonardo da Vinci II, the Vocational Training Programme (VTP) of European

* It was supported in part by BK21 and in part by ICU Digital Media Lab.

Community, is one of the outstanding examples of m-learning projects [1]. In this project, it is possible for a user to take lessons comprehensively with the provided mobility. Note however that memory storage of a mobile device is not sufficient to store information regarding to the lectures, and both process power and battery power are also not sufficient to provide various educational multimedia contents just in time. In addition, time delays of wireless networking may distract users from concentration on the educational contents.

In this paper, to overcome the disadvantages of conventional educational environments, we propose a u-education system in a smart environment with ubiquitous networking. Specifically, we limit the application area into the kitchen area, and apply the concepts to a cooking education class. A camera, which is mounted over a dressing table, detects menus on a cookbook and cooking materials stored in vessels, by recognizing markers that are attached on the cookbook and vessels' top. Then, a user can select a lecture movie and interactively control the lecture using predefined interaction markers.

CESUE guarantees a more facile cooking environment than before by allowing a user to have practical training in the kitchen using an interactive multimedia cooking class. Through a new type of tangible user interface, a user can take a lecture without any specific knowledge about computers. Due to its effectiveness, the framework of CESUE can be applied to various applications without any modification of system modules.

This paper is organized as follows: In Chapter 2, we describe the proposed education system in detail. Experimental results based on scenario and discussions are followed in Chapters 3 and 4, respectively.

2 Cooking Education System

CESUE, shown in Figure 1, consists of three modules, (i) a vision-based interface to recognize special markers in a cookbook, (ii) tangible interaction to control contents, and (iii) visual and sound feedback. We use three types of makers for menu, contents and controls, as shown in Figure 1.

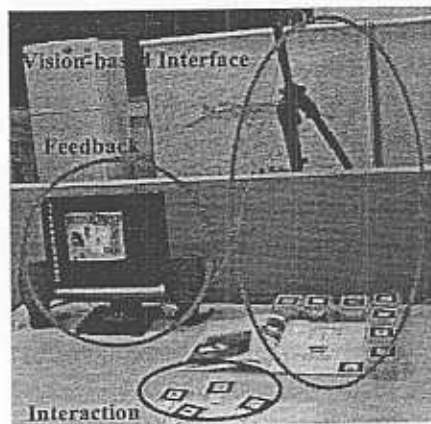


Fig. 1. System Configuration

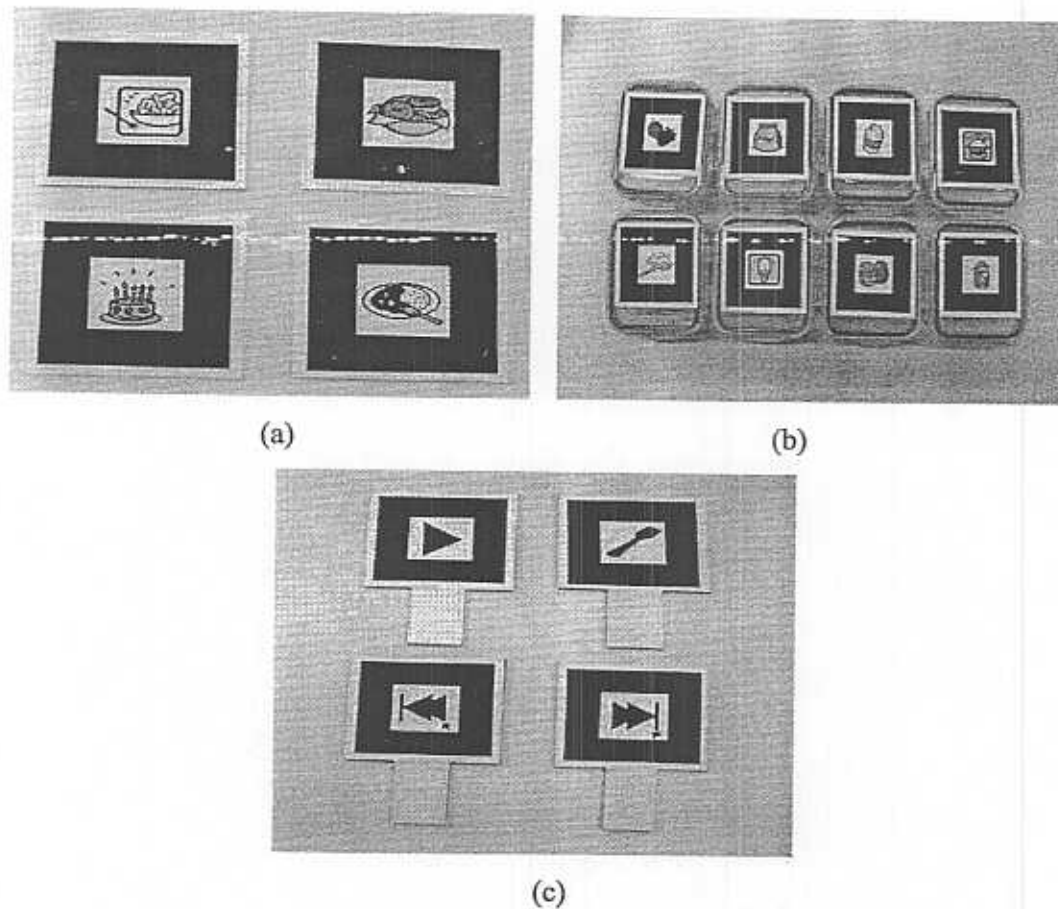


Fig. 2. Marker grouping, (a) menu markers, (b) material markers, (c) control markers

We attach content markers on the cookbook and vessels' top. The system recognizes the markers and displays a corresponding lecture movie onto the cookbook or 3D objects on the vessels, respectively. Besides a user can interact with displayed contents, the image of a moving picture augmented onto the cookbook can be displayed on the monitor in front of the user. The front space of monitor is arranged as a dressing table.

In the vision-based interface, CESUE obtains position information to augment the lecture movies and user's intention from the cookbook. 3D models for each cooking material are augmented on top of the marker using ARToolKit. First, through simple real-time image processing, camera and marker coordinates are obtained. ARToolKit calculates the relative translation and rotation information of a camera to the marker on the fly [2, 4, 5]. Then, the movements (rotations and translations) of a marker are traced in real time [3, 6, 7, 8]. Meanwhile, the system recognizes markers corresponding to each menu and material by using images obtained from the camera. Finally, the user can get corresponding visual and sound feedback through the monitor.

During the interaction phase, we use three groups of markers to provide the interactive cooking class to the user, as shown in Figure 2. The first group is the menu marker for identifying menus to trigger a corresponding lecture. The second group is the material marker for displaying 3D CG objects on the vessels that are interactively

selected according to the chosen menu. The third group is the control marker to select a menu and control the selected lecture movie. The system can provide effective cooking training because it is possible to select and repeat specific step of a cooking lecture, while practicing along the selected cooking class.

In the feedback module, CESUE provides visual and sound feedback when the user interacts with markers. Through the vision-based interface, CESUE recognizes a menu marker and a control marker, e.g., a selection marker. If a collision occurs between a menu marker and a selection marker, CESUE retrieve the lecture movie corresponding to the menu marker from a server through network. Then, it is augmented to be displayed on the menu marker. After the lecture movie is augmented, the user can control interactively using other control markers, e.g., replay, rewind, and forward markers. To provide a more effective class, CESUE displays visual signs as well as audio sounds when the interaction, collision between the content makers and a control marker is detected. In addition, the multimedia lecture movie is provided as a visual feedback

3 Experimental Results and Applications

To verify the effectiveness of the CESUE, we create a scenario as follows:

"A man is preparing a presentation for tomorrow's meeting. Suddenly, he feels somewhat hungry. Thus, he asks his wife to make a snack but she does not know how to make it. Thus, she goes into a kitchen and opens a CESUE-enabled cookbook. The page of the cookbook includes markers corresponding to the menu. Near the book, vessels with markers contain cooking material. When she finds out the menu in the cookbook, she chooses it by using the selection marker. After the selection, the lecture content is retrieved and displayed on the monitor located in front of her. During the first instruction, 3D models of needed materials to cook are augmented on the corresponding vessels. Now, she cooks just by following the instruction of each par. If she cannot follow a step for a while because of interruption such as a phone call, she can watch the missed step again by using a replay marker. Through this procedure, she can make the snack her husband asked."

In this section, we show the implementation of the proposed system. Figure 3(a) shows a marker-attached cookbook. And Figure 3(b) and (c) show the augmentation of a lecture movie as a result of a collision between a menu marker and a selection marker.

Figure 4(a) shows augmented 3D objects on the top of vessels according to the selected menu. As shown in Figure 4(b), the augmented CG objects on the selected vessel changes as the lecture proceeds.

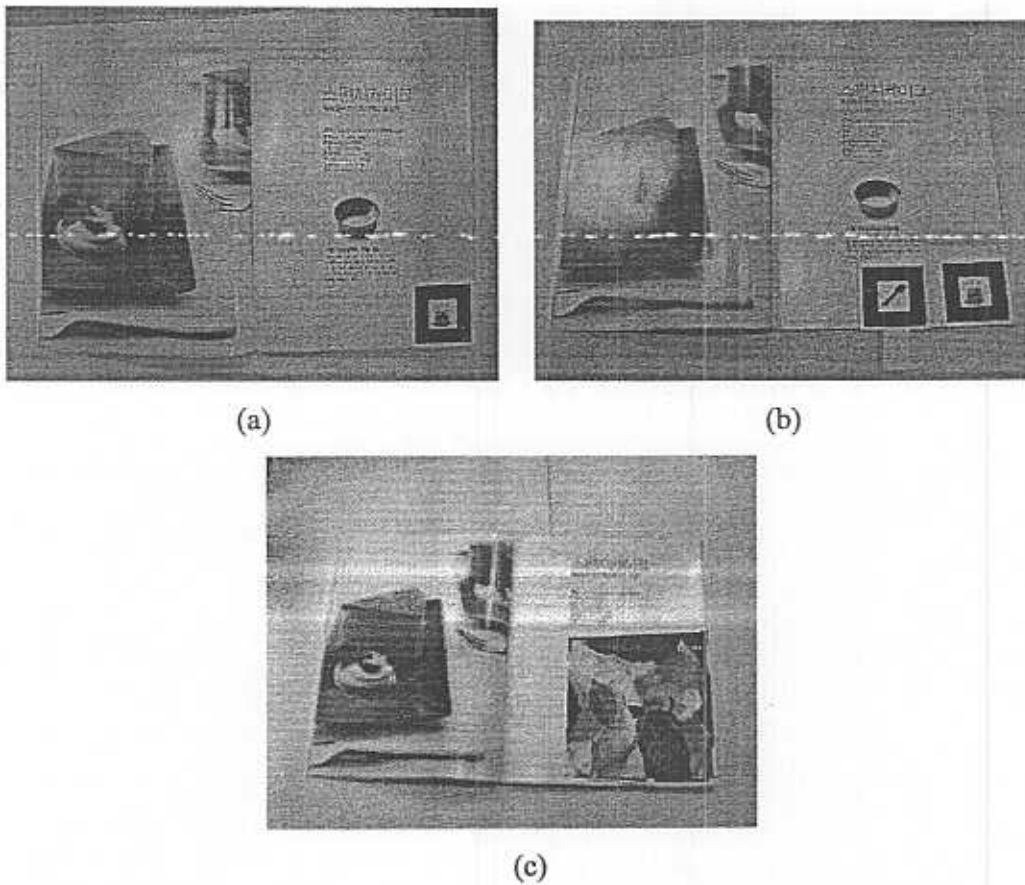


Fig. 3. Cooking book, (a) marker attached cooking book, (b) cooking book with the selection marker, (c) augmented result

As shown in Figure 5, a user interactively controls the lecture video clip with control markers. As a result, different color balls and the controlled lecture file are shown as a result of this interaction. Figure 5 (a), (b), (c), and (d) shows how the video clip can be changed according to the control markers, respectively.

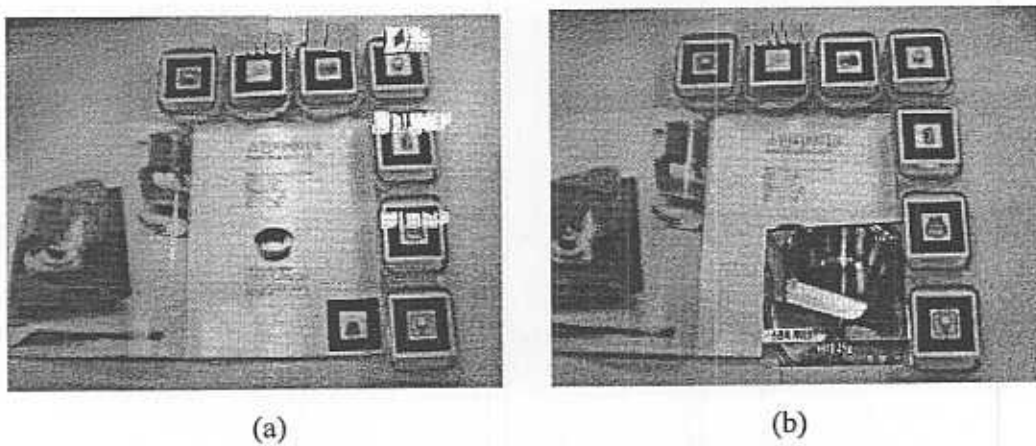


Fig. 4. Selected material markers (a) selected materials which is needed to cook the selected menu, (b) 3D objects which is displayed as the lecture proceed

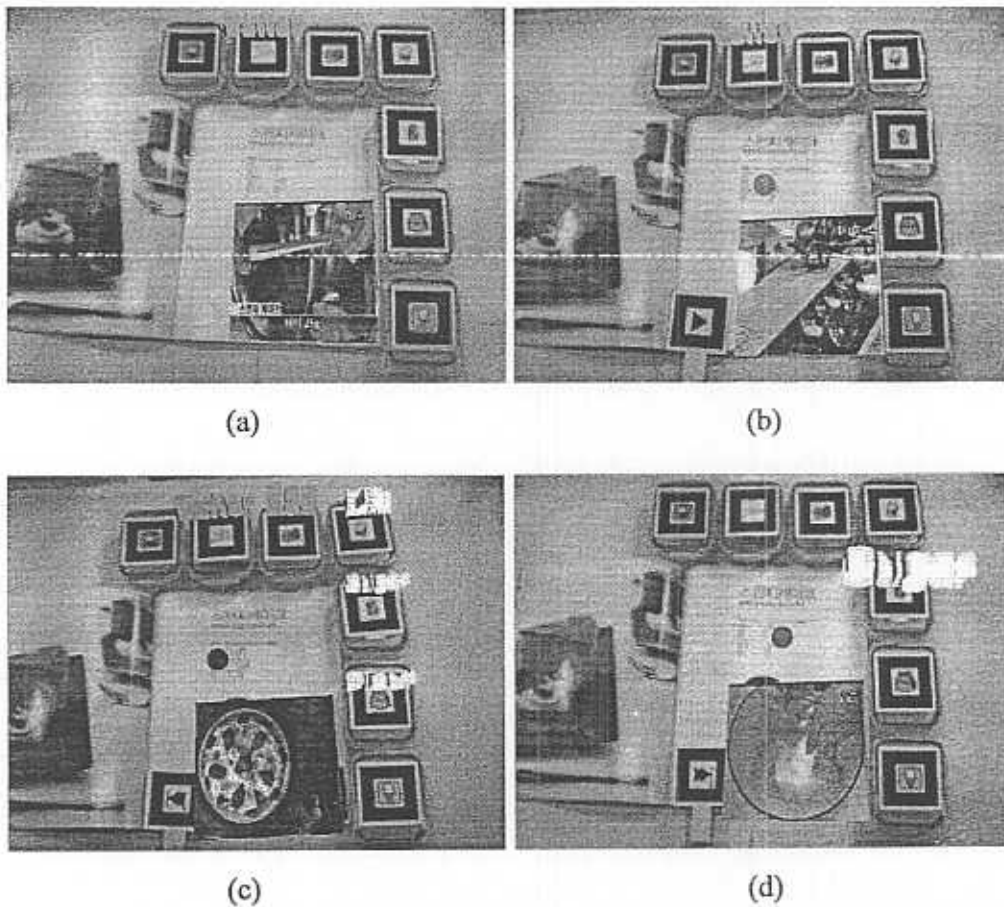


Fig. 5. Interaction with marker, (a), (b), (c), (d) lecture movie controlled by control marker and changed state of lecture movie

The proposed system can recognize a user's learning state through interaction pattern with the lecture material. According to preliminary experiments, we observed that even users (those who are not familiar with computer and the Internet) can exploit the cooking class using CESUE. Also, users felt CESUS was more efficient than conventional text-based or web-based cooking classes.

4 Discussions

In this paper, we proposed and implemented CESUS, a u-learning system, which provides a convenient cooking education environment to a user with the help of ubiquitous computing and augmented reality. The proposed system makes it possible to provide effective cooking training to the user by displaying multimedia lecture contents according to a menu marker on a CESUS-enabled cookbook in the kitchen. Using the CESUS a user can practice in a kitchen according to the procedure in the lecture contents retrieved through the network and interactively controlled by markers. One of the remaining challenges is to develop a cooking education system that can

provide user-centered cooking education by exploiting user's living pattern or diet habits as a context. The framework of the proposed CESUS can be expanded to various applications without loss of generality.

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