Development of An Intuitive Wearable Interactive System based on Augmented Reality and Object Recognition Technologies

Ko-Fong Lee [1], Kai-Yi Chin [2,*], Yen-Lin Chen [1], and Hsiang-Chin Hsieh[3]

[1] Dept. Computer Science and Information Engineering, National Taipei University of Technology, Taipei Taiwan
[2] Department of Digital Humanities, Aletheia University, New Taipei City, Taiwan
[3] Institute for Information Industry, Taipei City, Taiwan
[*] au0292@mail.au.edu.tw

***Abstract*-- The purpose of this study is to develop an Intuitive Wearable Interactive System (IWIS) based on augmented reality (AR) and object recognition technology, which comprises an object recognition module, an intuitive control module, an AR information display module and a server linking module, so that the users can master the AR information and 3D objects about the objects in an intuitive operation mode. This new technology application mode enables the users to view the information of virtual objects more easily and rapidly. This study combines the new object recognition technology with gesture recognition technology to generate a friendly man-machine interaction interface, the virtual information is integrated into the real world, applied to the smart glasses device, so that the users can interact with virtual information intuitively, which is integrated and used in ordinary life.**

I. INTRODUCTION

At present, the rise of many intelligent wearable mobile devices has been the focus of many markets, and various major brands have released wearable device goods actively, the market of intelligent wearable mobile devices has grown explosively. The intelligent wearable mobile devices include smart phone, smart watch, smart glasses and so on. The most noticeable one is smart glasses for the moment, which make the life interesting, and can be used in many areas. The main application equipment of smart glasses are transparent display, sensor, microphone, communication chip and so on, people's life style can be changed by the smart glasses based on these application equipment.

As stated above, the application equipment for display of smart glasses is transparent display. The transparent display is developed from general LCD. The transparent display is free of the back light of LCD, and the transparency of liquid crystal is enhanced, the natural light is used as light source. The information of display and background can be obtained simultaneously by using transparent display, and the energy consumption of strong light source is reduced by using ambient light, so as to save energy. All of transparent displays use the AR technology, which enables the users to experience innovation and convenience, so as to mix virtuality with reality [1], [2].

In addition, the mode of interaction between user and device is a subject worth discussing, and this research is known as human-computer interaction (HCI). The HCI also uses the gesture recognition technology, and the gesture recognition technology can detect the hand position rapidly, so as to detect the gesture information of hand [3], and the state machine is used for instruction control. The user interacts with the device naturally and intuitively, so that the acceptance of new device is enhanced. However, using computer to recognize human gesture automatically is quite challenging [4]. The gesture recognition requires many features in order to obtain useful information, and the human hand skin color, shape, size, camera distance and angle can change the image feature, and influence the accuracy of recognition. Therefore, the gesture recognition must have high accuracy and instancy, so as to meet the application requirement.

The purpose of this study is to develop a sort of smart glasses which can be controlled by gesture recognition technology, and the AR virtual information is displayed by object recognition technology to develop a new technology application mode, so that people can obtain the AR virtual information of objects easily and conveniently. Therefore, this study develops the IWIS based on AR and object recognition technology. Fig. 1 shows the usage scenario of IWIS. As long as the user wears the smart glasses, and uses object recognition technology to capture the eigenvalue of the background object, the object can be identified, and then the functions of smart glasses can be operated by the gesture recognition system. Afterwards, the user can request the IWIS to link to the database by demonstrating gesture, and to download the corresponding AR or 3D virtual object information, and then the virtual information is displayed on the smart glasses by the transparent display of smart glasses. The information about the objects can be known easily and directly through this intuitive interaction.

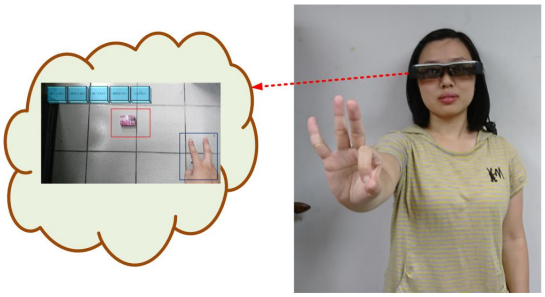

Fig. 1. The usage scenario of IWIS.

II. SYSTEM OVERVIEW

The IWIS is combined with AR technology application,

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image recognition, gesture recognition and server technologies, so that the user can implement image recognition according to his location with the assistance of smart glasses. When the corresponding AR information is downloaded, the 3D object is presented to the user in AR, so that the user can implement onsite guided learning in the exhibition area according to his preference and requirement. Fig. 2 shows the overall system architecture of IWIS, including two subsystems, which are "smart glasses side" and "AR object server". The glasses side operating function of IWIS comprises four modules, which are "object recognition module", "intuitive control module", "server link module" and "AR information display module", involving the object recognition, AR information content overlap and AR application technologies. The AR object server comprises two databases, which are "3D object database" and "AR information database". Its main function is to provide AR virtual information and 3D virtual objects.

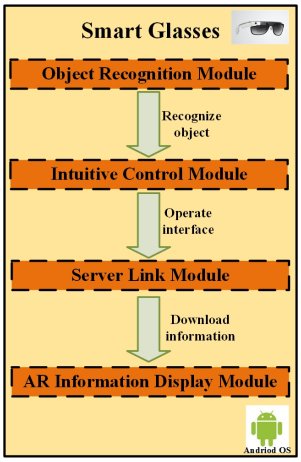

Fig. 2. The overall system architecture of IWIS

A. Paper Identification Line

The intuitive control module uses YCbCr [5] for skin color detection, uses HOG [6] feature to extract the hand image contour, and uses gesture recognition to operate and control interface. The intuitive control module recognizes relevant objects by object recognition module, so as to determine whether or not to know the object information. In addition, the operation mode is switched by the intuitive control module, so that the user can operate IWIS without keyboard or touch-screen.

B. Object recognition module

The main job of object recognition module is to recognize objects, the objects in the image are detected by recognizing the object eigenvalue, so as to implement recognition. Generally, the camera captures the data of background image to capture the eigenvalue of object, and then the object is determined by comparing the eigenvalue. When the object is recognized by the system, the AR information for the object is given. In other words, the object can be read by this method without reading the AR Marker, and the AR information about the object can be displayed.

C. AR information display module

In terms of the AR information display module, when the user recognizes the object, he decides whether or not to display the virtual information of object, and then the virtual object is projected on the transparent display of wearable smart glasses.

D. Server link module

The AR information and the 3D module corresponding to AR information proposed in this study are placed in the server database, the IWIS can link to the remote server by the server link module, and the AR information and corresponding 3D module can be downloaded. The downloaded information is sent to the AR information display module, so that the AR information display module can display the virtual information about the object.

III. CONCLUSION AND FUTURE WORK

This study introduces the IWIS, which enables the users to see the AR virtual information of the recognized object by gesture operation, and the 3D object is superposed on the target object, so as to complete the guided learning activity. However, there are still some defects after the system development, for example, the image recognition technology and gesture recognition technology are used simultaneously, the large amount of computation leads to system delay. The system fluency is expected to be enhanced by the most enhanced algorithm in the future.

In the future, the technologies developed in this study may be integrated into different application scenarios, such as tour guide, multimedia development, mobile teaching, factory management, administration of library, medical development and Big Data application, popularized to different research areas and related industries, hoping to develop a new application mode for relevant fields.

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