

# Implementation of HCI Software Interface based on Image Identification and Segmentation Algorithms

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**Abstract**— In this paper, we propose the new implementation of HCI software interface based on the image identification and the segmentation algorithms. Human-computer interaction refers to using the dialogue between man and computer language, in a certain way of the interaction, to determine the task of the exchange of the information between people and the computer process. The meaning of the image recognition technology is very wide, mainly refers to through the computer, using mathematical method, a system for the front-end to obtain images of treatment have been carried out in accordance with the specific purpose. Image segmentation is one of the most important content in the field of computer vision is the first to realize automatic image analysis and pattern recognition problem which is also one of the classic problems of image processing. We combine the mentioned techniques to form the optimized novel perspective of the HCI interface design that is innovative. The experimental simulation verifies the feasibility of the approach.

**Index Terms**— Software Interface, Image Identification, Image Segmentation, HCI, Algorithm, Implementation.

## I. INTRODUCTION

The development of modern computer science makes the development of human-computer interaction technology also appeared, the interface form has experienced from the first generation is based on the characters of command language interface to the current mainstream desktop graphical user interface leap, and the digital learning environment interaction experience got significant improvement. However, as more equipment equipped with sensors, microprocessors, network connection, at the same time, the Internet has developed into a senior can accommodate a variety of application platform, a variety of learning application development, "deaf" learning equipment upgrade, extension of virtual learning environment, make the means of interaction and interactive design with new content, desktop interaction patterns inherent problems also gradually exposed, and brought greater restrictions to the user action, desktop interaction is no longer the only center in the interaction design [1-2].

Human-computer interaction refers to using the dialogue between man and computer language, in a certain way of the interaction, to determine the task of the exchange of the information between people and computer process [3]. Among all the techniques for HCI, the image identification and the segmentation play the vital roles. The meaning of the image recognition technology is very wide, mainly refers to through the computer, using mathematical method, a system for the

front-end to obtain images of treatment have been carried out in accordance with the specific purpose. We can say, image recognition technology is the extension of the human visual perception. It is an important field of artificial intelligence, as with the development of computer technology and artificial intelligence technology, image recognition technology is more and more become basis of artificial intelligence technology. It involves technology is becoming more and more extensive, application is more and more deeply, the basic analysis method also along with the advance of mathematical tools and the continuous development [4]. Image segmentation is one of the most important content in the field of computer vision is the first to realize automatic image analysis and pattern recognition problem which is also one of the classic problems of image processing. The pros and the cons of the quality of the image segmentation, the regional boundaries positioning accuracy directly affect the subsequent description and image analysis and understanding is an important in the image processing, analysis, understanding of technology [5-6]. Correspondingly, the application scenarios also cover the machine learning [7-8], artificial intelligence [9-11] and data mining [12-13].

In this paper, to implement the human computer interaction system and integrate recent development of image processing techniques, we conduct research on the implementation of HCI software interface based on identification and segmentation algorithms. The rest of the paper is organized as follows. In the section 2, we summarize the literature reviews on the image segmentation and identification to serve as the basis. In the section 3 and 4, we propose our perspectives on identification and segmentation, respectively. In the section 5, we implement the HCI interface with the Kinect and test the robustness of the image processing algorithms. Finally, in the section 6, we make the conclusion and future research plan.

## II. LITERATURE REVIEW

Image segmentation is an important and difficult step in the field of image processing, from the key technology of image processing to image analysis, is an indispensable step in many intelligent image analysis systems. Therefore, researchers have payed special attention to the research field. In [14], Alpert proposed the probabilistic bottom-up aggregation and the cue integration based algorithm. Their probabilistic formulation takes into account intensity and texture distributions in a local area around each region. It further incorporates priors based on the geometry of the regions and eventually achieved the better

performance. In [15], Aranzazu constructed weak homogeneity from interval homogeneity with the related applications on image segmentation. They defined weak homogeneity of a fuzzy subset, which means that its membership function fulfills at least minimum properties required to represent homogeneity of region to serve as the novel approach for segmenting regions of interests (ROI). In [16], Li's group conducted research on the subspace multinomial logistic regression and the Markov random fields based framework for segmenting images. The maximum a posteriori segmentation is efficiently computed by the min-cut-based integer optimization algorithm that will enhance the performance of the traditional algorithms.

With development of computer technology and information technology, obtained more and more widely used in the image recognition technology. Such as medical diagnosis of all kinds of medical image analysis and recognition, the forecast of satellite cloud image recognition, the remote sensing image recognition, fingerprint recognition, face recognition, image recognition technology are increasingly penetrated into our life. In [17], Tao proposed the cascade fusion scheme for gait and the cumulative foot pressure image recognition. They proposed the two-step systematic framework to finalize the recognition task. In [18], Seidenari proposed local pyramidal descriptors for image recognition. They pointed out that image patches be represented at multiple levels of descriptor detail and that these levels be defined in terms of local spatial pooling resolution. Under their framework, the feature extraction procedures will be easier for later processing. More theoretical innovations within the image processing techniques could be archived in the literatures [19-32].

### III. IMAGE IDENTIFICATION ALGORITHM

The current image detection and recognition technology is one of the classic issues in the field of pattern recognition. Better solve the problem is now the plane figure of detection and recognition. Such as aerial image of target in the bridge road recognition, face recognition, handwriting recognition, industrial detection, etc. The focuses of the image detection recognition are: image positioning, feature extraction and target recognition, image edge detection. Image feature extraction and recognition is the core of image recognition technology. The low-level visual features include: color, texture and shape.

From the content point of view, the image processing can be summarized as the following six aspects. (1) Image coding, as required by satisfy certain fidelity, simplify, said of image to compress image data, in order to transport and storage. (2) Image restoration, its main purpose is to remove interference and fuzzy, restore the true colors of the image as classic examples such as the denoising belongs to image restoration processing as the image noise including random noise and coherent noise to deal with the fuzzy and recovery tasks. (3) The different objects in image analysis, image segmentation, classification, identification, description and explanation, and could be called the image recognition. Among them, the image analysis can be thought of as the advanced stage of the image processing. Image analysis of the main research is to use the machine around the visual image analysis and recognition, so

as to draw conclusive judgment that used to guide the further action this is actually the human visual system simulation and is also the most difficult of various brain functions simulation field. (4) Image enhancement, mainly highlight the needed information in image, and decrease or remove the car license plate recognition and parking lot management system design and implementation of information, in addition to don't need weaken the interference and noise, so that useful information is strengthened with differentiate or explanation.

With the development of science and the technology, color image has become a common form of image and color image recognition is the general focus of research. Color image edge detection, threshold selection is very important. In recent years, many scholars will be applied to the human visual system as characteristics of gray image edge detection, a lot of kinds of the nonlinear threshold selection algorithm are proposed.

Human visual system can identify the minimum difference of green function, poor minimum red and the blue difference function. Actual color image recognition, the need to deal with the image color values, so we will brightness space is mapped to the color space. Therefore, we suppose the  $G$  represents the pixel value,  $\Delta G$  denotes the human visual system for the color image edge just to identify green is poor as follows.

$$\Delta G = k \Delta I / I \quad (1)$$

In order to achieve the minimum differential green constant color background change we change the basic brightness of the golden section method is used to change the formula of interval mapping to the value of green change interval. We can know that the human eye to the sensitive degree of red, green, blue three colors are different, so it can be concluded that when the human eye observation to the color image, the same number of red, green, and blue color value in the eyes of the brightness of the different that could be expressed as the follows.

$$R / \bar{X}_{\max} = G / \bar{Y}_{\max} = B / \bar{Z}_{\max} \quad (2)$$

Differential operation on both sides, we have:

$$\Delta R / \bar{X}_{\max} = \Delta G / \bar{Y}_{\max} = \Delta B / \bar{Z}_{\max} \quad (3)$$

To sum up, only to choose the appropriate threshold, to the color images edge points accurately detected. Because under the background of different color, color difference of the human eye to the image edge was able to identify different, so under the background of a different color, and needs to choose different thresholds, in order to detect more accord with human visual characteristic of color image edge.

### IV. IMAGE SEGMENTATION ALGORITHM

Support vector machine as a new classification method has been used in the image segmentation and it can better using the statistical characteristics of the color image, and can avoid the optimal threshold difficult problem. Decision classification support vector machine uses the symbol function while it is equivalent to the interested area in color image transform to the gray image brightness range value in the supreme area, and then use the single global threshold segmentation. So just like other global threshold segmentation method, while this method cannot effectively eliminate and interested in similar regional characteristics of the target area, as also is unable to handle the

change of the local gray level image, segmentation result is not fine, need further segmentation in combination with the other methods. Region growing image segmentation method, which is based on predefined seed points, that will be interested in connected region extracted. If the combined support vector machine and region growing method, which can effectively eliminate and interested in similar regional characteristics of the target area. If can in the SVM and region growing method of combining the method of automatically selecting seeds for region growing method and similarity criterion, the method can significantly improve the ability of automatic segmentation. Division of the vast amounts of data such as virtual human data set is very meaningful.

Support vector machine is transformation function through the original input space vector is mapped to high-dimensional space. The SVM in the high-dimensional space use maximum edge for linear classification surface. Support vector machine method is used to do classification problem, need to select the corresponding nuclear, nuclear parameters and punishment and the original problem available mathematical description for the constrained nonlinear programming problem as the follows.

$$\begin{aligned} \min \Phi(w, b) &= \frac{1}{2} \|w\|^2 \\ \text{s.t. } y_i(x_i \cdot w + b) - 1 &\geq 0 \end{aligned} \quad (4)$$

Minimum norm satisfy the constraints of w is the normal of the optimal separating hyperplane based on the basic decision function for the optimal separating hyperplane as listed.

$$f(x) = \operatorname{sgn}\left(\sum y_i a_i \langle x, x_i \rangle + b\right) \quad (5)$$

Tectonic soft edge that allows existing fault samples the corresponding mathematical model for the batter optimization problem as the formula 6.

$$\begin{aligned} \min \Phi(w, b) &= \frac{1}{2} \|w\|^2 + C \sum \chi_i \\ \text{s.t. } y_i(x_i \cdot w + b) - 1 &\geq -\chi_i \end{aligned} \quad (6)$$

After the introduction of kernel function, when the samples in high dimensional feature space is not linear to time sharing, based on high dimensional feature space can be obtained in generalized decision function (DF) for the optimal separating hyperplane as the follows.

$$f(x) = \operatorname{sgn}\left(\sum k \langle w, x_i \rangle + b\right) \quad (7)$$

Using SVM method of image segmentation, the choice of the learning samples is often done by man-machine interactive way, because of the complexity of the image itself and the influence of noise, often cannot ensure that the training sample 100% represents the two points of the class. Although the SVM has stronger generalization ability, but too much ambiguity sample can increase the training time, reduce the segmentation quality. Region growing segmentation method is a kind of the segmentation method based on region. It is defined according to advance standards groups pixels or a larger area into a larger area of the process. Basic method begins with a set of "seed" point will be similar to seed properties of the adjacent pixels is attached to the area of each seed growth.

Seed point selection according to the nature of the problem to be solved, as usually choose one or more of the seed point. Similarity criteria depends not only on the problem of the face, but also related to the image type can be used for monochrome image based on gray scale and space description of the nature of the child to analyze the area. Define connected or adjacent information and it is to point to the connected area gradually generated from the seed point. Different definitions of the connectivity is one conforms to the rule of the similar nature whether pixels can be classified as growing area when no more pixels in area, region growing end automatically can also be defined in automatic growth before the end, some restrictive rules, makes the region growing to an end.

In combination with the SVM and region growing method of image segmentation, pixel must choose two methods for sample. A choose samples for training SVM as the SVM for basic image segmentation is supervised learning classification process, so before segmentation must choose on behalf of the pixels of all kinds of areas as secondly, selected seed region growing method. The stand or fall of the seed point selection often decide whether algorithm can effectively put forward and interested in similar regional characteristics of the target area.

## V. HCI INTERFACE WITH THE KINECT

Somatosensory interaction is a kind of RBI, emphasizing the use of body movements, gestures, voice, etc. of the existing knowledge and skills in real life for human interaction, without the need for additional learning too much new knowledge. Somatosensory interaction began in the game industry, that obtained the rapid development in recent years, including Microsoft development of image recognition, video capture, voice control and other technology in the integration of body sensor device, realized without using any handheld device, can by hand gestures and body movements, voice and other natural way and the terminal interaction.

Natural body feeling interaction can better meet the core demand of 3D interaction in virtual learning environments, such as, the 3D virtual experiment system, three-dimensional education the game's general interactive applications. Although existing 2D human-computer interaction design experience can provide the beneficial reference for body feeling interaction design, but the body feeling interaction is applied to the three-dimensional learning system in the way of the interactions involved, interaction, interface, interaction, evaluation, etc. all have new content, so need a new interaction design.

Somatosensory interaction by the user's hand gestures and body movements, voice and the way of the virtual human technology to accomplish interaction tasks while the gesture including static and dynamic, static gestures by static gesture recognition system to use different gestures to represent different interaction semantics, and dynamic hand gestures is by extracting movement characteristics of gestures, such as the guidance, pointing and guidance trajectory to achieve more intuitive interaction, such as the view of the picture, the rotation of the model and so on. Device body sensor can also be real-time tracking the depth of the real scene in the user information to identify the body and bone node position and

posture, gesture interaction. The built-in microphone array can receive signals from different azimuth of general voice, voice interaction control. Virtual human is an avatar of 3D virtual environment the user, the user gestures, body movements, such as voice that can be used to directly control it, to assist the user through interactions with the virtual scene.

The characteristics of the technique could be summarized as the follows. (1) The implication interaction information. Implication is refers to the user in the process of interaction, don't need to pay attention to the task execution mode and process, focus on the task itself. Somatosensory interaction using natural directly with the learning object interaction, the verbal habits can dilute the user's perception of are using computer, strengthen the learning situation and learning tasks. Interaction of implicit performance to avoid learning complex interface and increase cognitive load, enhance the efficiency of interaction. (2) The continuity of mutual information. Using somatosensory interaction, is continuous input and feedback of information, you can use gestures to complete this several operating directly, even can be synchronized, the coherent operation bring users real sense reality. (3) Multidimensional nature of the interaction information. Interactive channel broke through the WIMP of the using of the eyes and the way of the fingers, only increase the hearing, speech and body movements such as interactive channel as multidimensional performance better match the 3D interactive environment, and from the sense perception, the behavior way and the use of space and so on to improve the interaction.

On the basis of this model in the architecture design and implementation of human-computer interaction framework using the proposed design method, the framework can not only meet the demand of the practical application of the human-computer interaction framework, but also has the following three prominent advantages. (1) Module inside has a strong cohesion, every module to realize the function of independent, to other modules depend on small, a module of change is not big influence on other modules is conducive to the coordinated development. (2) Interface and data of low coupling, that is, to display interface and data processing of completely separated, interface and data independent modules, respectively, as the interaction between them down to a minimum. (3) Mainly used in the design of MVC, the factory pattern and popular design patterns such as the Observer pattern, the program structure is clear that is easy to understand.

## VI. EXPERIMENT AND VERIFICATION

In this part, we simulate the proposed algorithm with the experimental verification. In the figure one, we simulate the image segmentation algorithm on the natural scene with the sample database from [28]. In the figure two, we demonstrate the visual tracking and the image identification methodology that proves the effectiveness of the method. In the figure 3, we show the sample interface for the HCI interface segmentation with the Kinect implementation. We could conclude from the experimental result that the proposed algorithms achieve the satisfactory result and the designed interface is obtains the well-performed user experience.

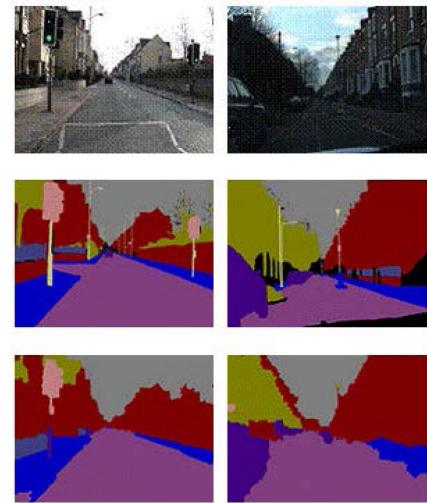


Fig. 1. The Experiment on the Image Segmentation

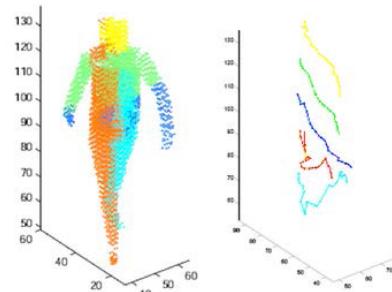
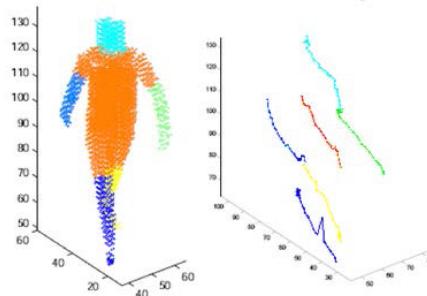


Fig. 2. Experiment on the Visual Tracking



Fig. 3. Demonstration of the HCI Interface

## I. CONCLUSION

Human-computer interaction (HCI) refers to using the dialogue between man and computer language, in a certain way of the interaction, to determine the core task of the exchange of the information between people and computer process as among all the techniques for HCI, the image identification and the segmentation play the vital roles. To enhance the performance of the traditional system, in this paper, we propose the new implementation of HCI software interface based on the image identification and segmentation algorithms. The experimental result proves the effectiveness of the method. In the future, we will conduct hardware implementation of the framework to verify the further feasibility.

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