Static Hand Gesture Recognition for PowerPoint Presentation Navigation using Thinning Method

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Abstract—In this paper a method to control the power point presentation navigation using bare hands, is proposed. The proposed method takes static hand gestures as input via webcam connected to the computerand uses thinning method to obtain the hand shape parameters. Thesehand shape parameters are used to countthe number of raised fingers. Based on this count, the gestures are identified and then used to control the slides. This method does not require devices such asmarkers orgloves or any other devices andalso does not require any database to identify a gesture.

Keywords-Gesture Recognition; Segmentation; Static Hand Gesture Recognition; Thinning.

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I. INTRODUCTION

Gesture is defined as an expressive movement of body parts which has a particular message, to be communicated precisely between a sender and a receiver. A gesture is scientifically categorized into two distinctive categories: dynamic and static .A static gesture is a particular hand configuration and pose.. A dynamic gesture is a moving gesture.A dynamic gesture is intended to change over a period of time whereas, a static gesture is observed at the spurt of time. A waving hand means goodbye is an example of dynamic gesture and the stop sign is an example of static gesture.

Gesture recognition is a hot area in human-computer interaction. It's natural, intuitive and easy to learn. Today, gesture recognition, and especially hand gesture recognition, has different and considerable applications, such as; vision and robotic [1-2], computer games, communication deaf people with computer [3-5], and emotional recognition.

The current gesture recognition system can be mainly divided into Data-Glove Based and Vision Based approaches. Data-Glove Based system based on the data glove requires the user to wear custom data gloves[6].These methods use sensor devices for digitizing hand and finger motions into multi-parametric data. The extra sensors make it easy to collect hand configuration and movement. However, the devices are quite expensive and bring much cumbersome experience to the users. In contrast, the Vision Based methods require only a camera, is more simple and convenient provides users a more natural and directly way to interact with computer.

This paper proposes a system based on static hand gesture recognition technology to control the slides of PowerPoint presentation in a device free manner. Using the palm side of right hand the gesture is given as input to the webcam connected to the computer. Then using a method based on thinning, which counts the number of raised fingers, the gesture is recognized and the slideshow is controlled.

II. RELATED WORKS

The Hand gesture recognition research has been grown rapidly since 2005.There have been varied approaches of gesture recognition ranging from statistical modeling such as Principal component Analysis (PCA)which is used to extract the features from the hand gesture's images, Fuzzy Decision Tree [7] and Hidden Markov Model (HMM)[8]which are used to model wide range of data, to approaches based on soft computing tools such as Artificial Neural Networks(ANN) [9]. Some other important researchers have worked on different deaf people languages processing, Rokade et al [10] used thinning method on one to ten numbers of American Sign Language (ASL). The feature vector consists of angle between the lines, which join center point to each endpoint and center point to the vertical extended line. As the feature vector contains some corners, the method required vertical hand images as input.AlaaBarkoky et al[11]used thinning method on one to ten numbers of Persian sign language(PSL) using thinning method on segmented image. In this approach, after cleaning thinned image, the areal endpoints have been used for recognition. The method is qualified to provide realtime recognition and is not affected by hand rotation and scaling.

Another alternative approach for the same purpose use different shape based features for hand gesture recognition. The paper [12]for hand gesture recognition is based on shape features. The strength of this approach lies in the ease of implementation, as it does not require any significant amount of training or post processing and it provides us with the higher recognition rate with minimum computation time.

III. PROPOSED SYSTEM

The Gesture Recognition System takes the input hand gestures through the in-built web camera at a resolution of 320 x 240 pixels. The images are captured in a high intensity environment directed to illuminate the image source which is held at black background so as to avoid shadow effects. The images are captured at a specified distance (typically 1.5 – 2 ft) between camera and signer.The gestures are given by palm

side of right hand. The captured video is then processed for Hand motion detection and it is done using SAD method[13]. Then the segmentation of hand is carried out. The segmented hand image is used for finding features. These features are used for gesture recognition. The final result obtained is used to control slide show.

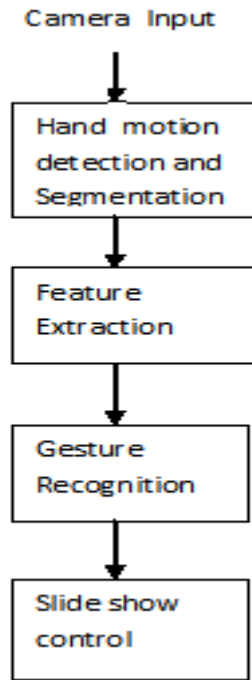The system consists of 4 modules: Hand motion detection,Segmentation, Feature Extraction and Gesture Recognition.

Camera Input

Hand motion detection and Segmentation

Feature Extraction

Gesture Recognition

Slide show control

Figure 1.System Overview

A. Hand Motion Detection

For checking whether any motion is present in the live video feed, the live video frames being provided by the webcam must be compared with each other by using motion detection algorithm. In this paper ,Sum of absolute differences (SAD) method is used for motion detection.SAD is a widely used simple algorithm for measuring the similarity between image blocks. SAD algorithm is summarized in following steps:

1.A threshold is set which is more than camera noise level.

2.Take the absolute difference between each pixel in the current image and the corresponding pixel in previous image.

3.These differences are summed to get Sum of absolute difference and it is normalized.

4.The variance value is computed after collecting two SAD values.

5.If the variance is below threshold ,then there is no motion detected.

Ifmotion is not detected, the current image is given to segmentation module.

B. Segmentation

In this step ,hand is segmented from the background. The image in RGB color is converted into gray scale image which is in turn converted into black and white image. Filling is applied on the image which leads to the filling in of the holes inside the hand region.Blob Analysisis performed to obtain the largest white area in a binary image as the hand. Now, vertical

orientation is performed, during which the main axis of the hand image (the longest axis) is identified and is then rotated by the required angle to correct it to the upright position, so that the hand gesture image will be vertical [14]. To smooth the edges, morphological filters dilation and erosion are used. Now separate the arm from palm on the basic idea that arm is thinner than palm.

C. Feature Extraction

In this step, the binary image is processed using thinning operation, which is a morphological operation that is used to remove selected foreground pixels from binary image. This produces another binary image which is skeleton image. This image is used for extracting the end points. According to 8-connectivity neighbors, the endpoint is a point that contains only one 8-connectivity neighbors and represents the terminal pixel of the thin segment. Fig .2 shows the end points.
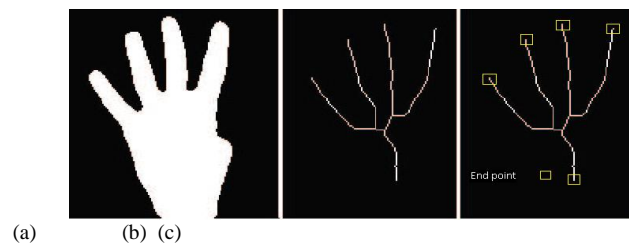

(a)   (b) (c)
Figure2. (a)Segmented image, (b) Thinned image and (c) End points in thinned image.

D. Gesture Recognition

After extracting features finger width c and length l of the input image, gesture recognition is performed by counting the number of end points corresponding to raised fingers. The algorithm is as follows:

1. Calculate $w=c+6$.

2. Take an end point with highest x-coordinate value, traverse thin segment by 10% of length. Let the point that is reached, be 'p' and take its corresponding point 'q' in hand image.

3.From this point, move to a pixel, which is vertically up for $w/2$ pixels and check this pixel. Similarly, from q move to a pixel, which is vertically down for $w/2$ pixels and check this pixel. If both pixels are black then, then end point corresponds to a raised finger.

4.The steps 2and ,3 are repeated for other end points, but moving is performed horizontally.

The number of end points corresponding to raised fingers is used to control the slides of PowerPoint.

E. Conrol the Slideshow usinghand gestures

The recognition of gesture depends purely on the number of raised fingers.So any finger canbe used to denote a count. Only the count value of the raised fingers is taken as input. Here, the user can feel free to represent a count irrespective of the finger. Hence, value one denoted using the thumb or index finger will be the same as shown in Fig. 3 (a) and (b).

Figure3. (a) and (b) various gestures to represent number one

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The gestures used to control the slide show are mentioned in Table 1.

TABLE I GESTURES AND THEIR FUNCTIONS

Finger count	Function
1	Next slide
2	Previous slide
3	Go to slide 1
4	Go to last slide
5	Stop slide show

IV. EXPERIMENTAL RESULTS

For algorithm implementation, MATLAB software is used on a system with Intel core i3 processor with speed of 2.30 GHz .The hand gesture is by found by counting the number of raised fingers and then gesture is mapped to a particular action using methods of COM(Component Object Model). The proposed system was tested with 100 images in the dataset and dataset is made to contain different sample models such as rescaled and rotated samples between +45 and -45 degree. Table 2.shows the hand gesture recognition rate.

TABLE II GESTURES AND THEIR FUNCTIONS

Gesture	Input Image	Successful Cases	Recognition Rate	Elapsed Time
1	20	18	90	0.84
2	20	19	95	0.85
3	20	19	95	0.85
4	20	18	90	0.84
5	20	20	100	0.82

The average recognition rate is 94% with average computation time of 0.84 second for recognizing single image. Errors may result from the variety of factors, such as changing illumination, due to human nature to place the hand away from the focus of the camera, and improper gestures. Problem occurs if the fingers are not stretched properly while making a gesture.

V. CONCLUSION

This paper presented a real-time static hand gesture recognition controlling power point navigation. The algorithm is based on thinning method and it extracts hand shape parameters for gesture recognition. The hand gestures are recognized based on number of raised fingers used to represent a gesture. So gestures can be made using any finger. The proposed methoddo not require any training phase to identify the hand gestures. Hence does not require storage of images in database to recognize the hand gestures. The system is suitable for single handed gestures. The average hand gesture recognition rate is 94% and computation time is 0.84 second according to 100 sample tests including orientation of hand placement between +45 to -45 degree. In this method certain parameters and threshold values are defined experimentally after testing number of images. The system can be extended to achieve gesture recognition in any complicated backgrounds also usage of hand gestures can be extended to control real time applications like VLC media player, paint, game applications etc.

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