Restoration of Images using Dynamic Hand Gesture Recognition

Madhuri Lokhande[1], Shabnam Shaikh[2]

[1]Computer Department, AISSMS, Collage of Engineering, Kennedy Road, Pune, India

[2]Professor, Computer Department, AISSMS, Collage of Engineering, Kennedy Road, Pune, India

Abstract: *In this paper, hand gesture recognition system is introduced for continuous gesture recognition. Our real time hand gesture recognition system is divided into three modules; skin detection, feature extraction and gesture recognition using decision tree id3 algorithm. For tracking the hand in real time, opencv library of image processing is used. Decision tree id3 algorithm is used for recognition of gesture in real time. With the help of real time hand gesture recognition, Image restoration operations such as denoising and deblurring are done. We can recover the historical images or images that contain degradation using image restoration. Non local kernel regression algorithm is used for image restoration. All image restoration operations are carried out using hand gesture recognition in real time so it eliminate the dependency of using any computer application with the help of physical device.*

Keywords: Decision tree, Image Deblurring, Denoising, Image Restoration, Hand Gesture Recognition

1. Introduction

Hand gesture recognition is a communication media through which we can interact with the devices. Gestures recognition permit human to communicate with machine and interact more naturally without using any physical devices. Various approaches have been reviewed for hand gesture recognition which include glove based and vision based method. In glove based method, user needs to wear cumbersome devices to perform mouse actions by carrying the load of cables that need to connect to the machine. Vision based method is used for object localization and gesture recognition. Gestures can be categorised as static and dynamic. Static gestures contain the fixed defined posture and dynamic gesture include message indicated through hand in real time. Hand gesture recognition includes hand tracking using skin color detection, feature extraction and gesture classification. Sheng-Yu Peng [3] has used skin color detection using ycbcr spaces and camshift for tracking of hand. Hand gestures are classified using principle component analysis.

Prashan Premaratne [5] has used Lucas-Kanade method for hand tracking; template matching, Fourier descriptor and movement invariants for feature extraction and support vector machine for gesture classification. Hidden Markov model is used in [9] for training and gesture classification. As a feature vector they have combined spatial and temporal features of the input image sequences. Several approaches for hand gesture recognition and image restoration techniques are given in paper [4].

Image restoration is used for reducing the degradation present in images. Degradation in images occurs due to lack of prior knowledge, unwanted signal occurrence, and Device noise. Image restoration is very useful technique in image processing which estimate good quality images from low/poor quality images.

For solving the problem of balanced regularization in frame based image restoration, efficient alternative direction method of multiplier is used in [7]. The analysis-based and synthesis-based approaches in image restoration are equalizes using balanced regularization. Bilateral Markov mesh random field (BMMRF) is used in [6] that generate similar and corner independent Markov Random Field. Taeg Sang Cho [10] has developed iterative convolution algorithm for gradient distribution matching. It matches the gradient of reconstructed image with the desired distribution. They have proposed two approaches that are kullback-leibler and cumulative penalty function for significant gradient distribution.

2. Architecture of Proposed System

The proposed system captures the hand gesture with the help of webcam. Hand gesture recognition include skin color detection for detecting the hand color, feature extraction for detecting fingers of hand and gesture recognition for detecting the events indicated by the user. After detection of hand gestures properly we can perform all mouse operations using hand gestures such as mouse move and left, right click. We can select degraded image as input for image restoration application by using events indicated by hand. Non local kernel regression algorithm is applied on degraded image to recover it from degradation. Final recovered image is generated after reconstruction is carried out on image. The architecture of proposed system is shown in figure 1.
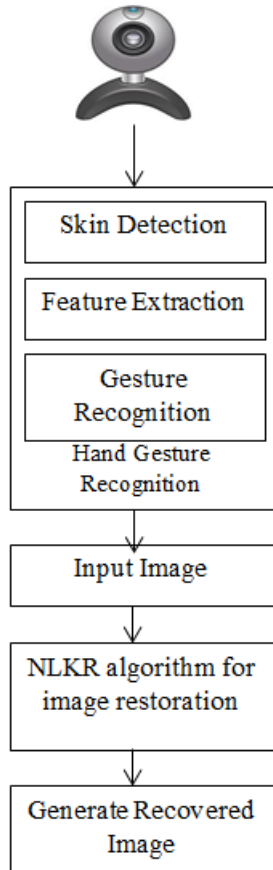
Paper ID: SUB156943

2097

Figure 1: Architecture of system

3. Hand Gesture Recognition

Typically, Gesture recognition methods contain three major steps; 1) Skin detection, 2) Features extraction and 3) Gesture recognition/Behavior analysis.

3.1 Skin Detection

For hand detection, skin detection algorithm is used for detecting the hand region in the frames captured through webcam. The skin detection algorithm is useful for detecting the skin area in the frame and avoiding area that is not a skin. Skin detection is one of the segmentation techniques that separate the hand region from other moving objects. HSV color model is used in our system for detection of skin color of hand region. The HSV color space is used here because it is more likely as the skin color. Thresholding is applied on input frames for segmenting hand region from background. Median filter [2] is applied on binary image to remove the noise from binary image.

After skin detection we need to outline the skin region to represent the hand area and to find other features of hand. Contour finding means finding the points that represent the curve in an image. Contour is used for searching the human hand and discarding other skin colored objects that are present in the frames. For contour drawing on the objects that are in frames, it is common to nearly correct the contour that represents a polygon with another contour which has less vertices.

3.2 Feature Extraction

After obtaining contour of hand region, we need to extract some features from contour. Fingertips are used as good features of hand. For performing mouse events using hand we can use fingers to indicate the gestures. For fingertip point's extraction, convexity analysis of contour is used. By using convex hull with convexity defects we can get the shape of contour or object. For resolving the complex object shapes, convexity defect is used. Opencv library of image processing is used for skin detection, contour, and finding fingertips of hand. Figure 2(A) shows the contour of hand, (B) shows convex hull and (C) shows the convexity defects on hand and (D) is the final image which contain the hand region.
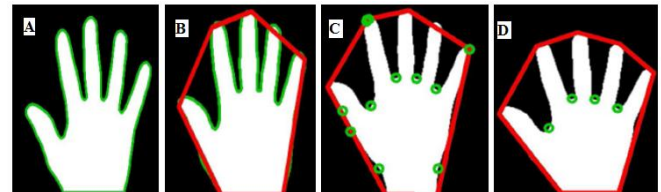

Figure 2: Features of Hand

3.3 Gesture Recognition

For recognition of gesture, there are some algorithms such as hidden markov model, artificial neural network, principle component analysis, decision tree algorithm, finite state machine, conditional random field etc. In our work we have used decision tree algorithm because it is able to classify gestures quickly. Decision tree algorithm is trained for carrying out events indicated by user. For detection of events we have train the decision tree classifier as; if 4 fingers are shown then mouse move operations will start and 5 fingers for existing from mouse moving operations. When we are using mouse move operations, we can move it to required place by using fingers like 1 finger for moving mouse upward, two fingers are used for moving mouse downward etc. 1 finger is used for left click and 2 for right click operations after existing from mouse move operations. Events classifications are done through the decision tree are shown in figure 3.
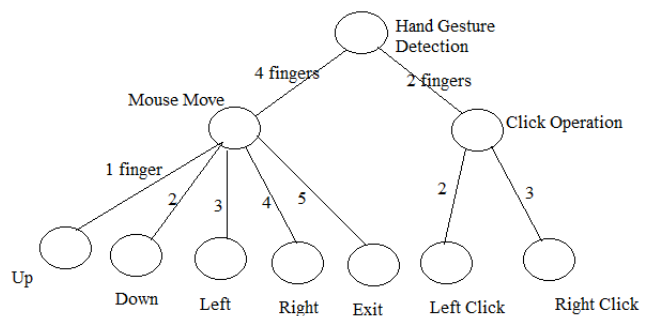

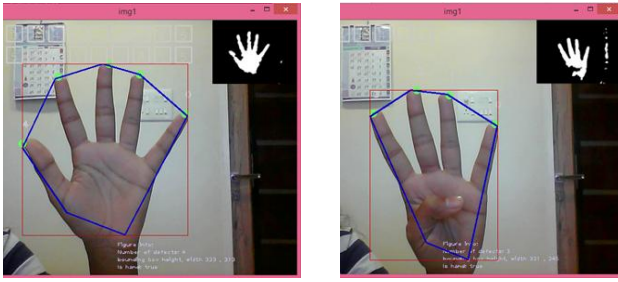**Figure 3:** Event classification using decision tree

Figure 4: Results of hand gesture recognition

Figure 4 shows the hand gesture results obtained using this system. Red color box shows in image is the bounding box, and green points are the finger points. Blue curve shows the convex hull.

4. Image Restoration

Image restoration mainly used to remove or reduce the degradation that is present in images. The noise and blurriness is reduced from image to improve the quality of image. Noise means unwanted electrical fluctuations or signal that are present in images. Noise comes mainly in digital image during image transmission or image digitization. During acquiring images, the main common source of noise in image is the sensor temperature. Common noise models are uniform noise, gamma noise, Gaussian noise, salt & paper noise, Rayleigh distribution etc.

For removing or reducing noise, filtering methods are studied [8] that are linear filter and non-linear filter. Mean filter is used for removing the impulsive noise but it does not preserve the details of images. Median filter is used for denoising different noises. wiener filtering is used for filtering the noise that has the corrupted signals. Non local kernel regression algorithm is used in this work for removing noise and blur from images. A non-local kernel regression uses local structural regularity and non-local similarity for restoration of images. The non-local uniqueness finds the same patches present in image. These patches regularize the noisy patches/pixels using local structural regularity that are found using the non-local similarity search. By exploiting both these methods we get the more robust results than other filtering methods.

In patch searching method, for finding similarity several color are used such as red color for more similarity of patch, green for low and blue for least similarity. The local structural kernel method forms the regression kernel to the structure at each position where similar patches found and reweight them depending on the uniqueness. By combining the results of local structural regularity and non-local resemblance information, NLKR calculate the value for given location. The image denoising superiority can be improved by using non local kernel regression iteratively [1].

Image Denoising Algorithm
1. Input: Noisy image and No.of iterations
2. Initialize estimation of current denoising
3. For 1 to N do
4. For every pixel location on the grid of image do

   a. Estimate index set of similar patches according to denoising estimation
   b. Compute structural kernel
   c. Estimate weight matrix using structural kernel
   d. Compute regression coefficient
   e. Update estimation of denoising
   f. Update image gradient
5. End
6. End
7. Output: Denoised Image

Structural kernel and regression coefficients are computed in same manner as in [1]. Gaussian kernel is as shown below is used for assigning weights to the pixels that are nearer to the patch.

$$w_{ij} = exp\left(\frac{-||R_{x_i}y - R_{x_j}y||^2_{W_G}}{2\sigma^2}\right) \tag{1}$$

Where w_{ij} is calculated among the location x_i of interest and another location x_i of similar patch. From Gaussian kernel weight matrix, W_G is constructed which gives larger weights to nearer pixels.

Before denoising   After Denoising
Figure 5: Image denoising

Digital images get blurred due to atmospheric disturbances and Poor quality of focus. To check the blurriness in image, the process of blurring needs to be converted into frequency form. For checking frequencies present in the image Fast Fourier transformation is applied. If low amount of high frequencies is present then the image includes blurness. If high frequencies amplification is present, noise amplification can occurs. Wiener filtering method [1] is used for noise filtration. Single image deblurring process is as follows:

$$n = Hc + \epsilon = h * c + \epsilon \tag{2}$$

Where, c represents clean image, n represent noisy, blurry image and H is the operator for blurring. ϵ is a Gaussian noise. Frequency Domain representation of single image observation is as follows:

$$N(u,v) = H(u,v)C(u,v) + \varepsilon(u,v) \tag{3}$$

Image Deblurring Algorithm:
1. Input: Blur image, blur kernel
2. Estimate frequency representation using fast Fourier transformation.
3. Perform filtering using wiener filter
4. Produce spatial domain estimation by applying inverse FFT

5. Perform non local kernel regression denoising to generate the final deblurring result
6. Output: Deblurred image

Figure 6 shows deblurring results by using non local kernel regression algorithm.
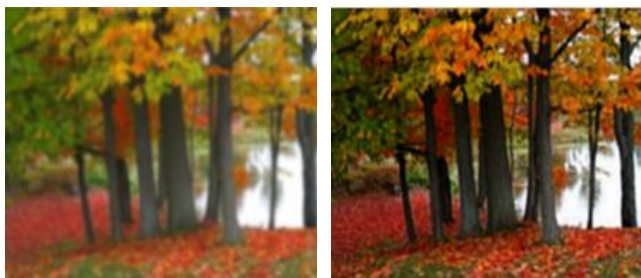
Before Deblurring   After Deblurring
Figure 6: Image Deblurring

Table 1: Hand Gesture Recognition Accuracy

Gestures	No of Images Tested	Correctly Recognized	Incorrectly Recognized	Accuracy
1	21	19	2	90.47%
2	20	18	2	90%
3	25	23	2	92%
4	20	19	1	95%
5	20	19	1	95%

By using properties of both similar patch searching and structural kernel estimation, we get good results for image denoising and deblurring as compare to other algorithm reviewed in literature. Less time is required for removing noise and blurness from image as compared to NL means, local mean and iterative convolution algorithm.

5. Conclusion

Real time hand gesture recognition system is developed whose goal is to create a system that can identify human generated gestures and use this information for device control and various operations on image restorations. For classification of gestures decision tree algorithm is used. This system is useful for users who lack the strength and precision used to operate the traditional input devices. Denoising and deblurring image restoration operations are performed using non-local kernel regression method. Future work would include developing faster algorithm for hand gesture recognition and image restoration. We can develop hand gesture recognition for controlling other applications and gadgets.

References

[1] Haichao Zhang, Jianchao Yang, Yanning Zhang , Thomas S. Huang, "Image and Video Restorations via Nonlocal Kernel Regression", Ieee Transactions On Cybernetics, Vol. 43, No. 3, June 2013.

[2] Alper Aksaç, Orkun Öztürk, and Tansel Özyer, "Real-time Multi-Objective Hand Posture/Gesture Recognition by Using Distance Classifiers and Finite State Machine for Virtual Mouse Operations", ieee Electrical and Electronics Engineering (ELECO) , 2011 7thInternational conference on 1-4 Dec 2011.

[3] Sheng-Yu Peng, Kanoksak Wattanachote, Hwei-Jen Lin, Kuan-Ching Li, "A Real-Time Hand Gesture Recognition System for Daily Information Retrieval from Internet", IEEEFourth International Conference on Ubi-Media Computing, 978-0-7695-4493-9/11 © 2011.

[4] Madhuri Lokhande, Shabnam Shaikh, "Literature Survey on Image Restoration Using Hand Gesture Recognition", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 4, Issue 11, November 2014.

[5] Prashan Premaratne, SaboohAjaz, MalinPremaratne, "Hand gesture tracking and recognition system using Lucas–Kanade algorithms for control of consumer electronics", SciVerse ScienceDirect Neurocomputing 116 Elsevier (2013) 242–249

[6] S. Yousefi, N. Kehtarnavaz, Y. Cao, Q.R. Razlighi, "Bilateral Markov mesh random field and its application to image restoration", J. Vis. Commun. Image R. 23 (2012) 1051–1059 Published by Elsevier Inc.

[7] Shoulie Xie, and Susanto Rahardja, "Alternating Direction Method for Balanced Image Restoration", ieee transactions on image processing, vol. 21, no. 11, november 2012.

[8] Priyanka Kamboj and Versha Rani, "A Brief Study Of Various Noise Model And Filtering Techniques", Journal Of Global Research In Computer Science Volume 4, No. 4, April 2013.

[9] Feng-Sheng Chen, Chih-Ming Fu, Chung-Lin Huang, "Hand gesture recognition using a real-time tracking method and hidden Markov models", Image and Vision Computing 21 (2003) 745–758 Elsevier Science.

[10] Taeg Sang Cho, C. Lawrence Zitnick, Neel Joshi, Sing Bing Kang, Richard Szeliski, and William T. Freeman, "Image Restoration by Matching Gradient Distributions", ieee Transactions On Pattern Analysis And Machine Intelligence, Vol. 34, No. 4, April 2012.