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Literature Survey on Image Restoration Using Hand Gesture Recognition

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Abstract— Restoration and recognition of image and video has been of very important nowadays. The shelves of digital libraries that are present throughout the world contain thousands of historical images and videos that are needed to be scanned to provide access to the information they contain. The problems faced in this are degradation (noise, blur), which reduces the visual quality of images and videos, and it is difficult to decipher. Hand gesture recognition is very significant for human computer interaction. This review contains image and video restoration through hand gesture recognition. In this survey we review different methods of image restoration and hand gesture recognition and identify the best suitable method.

Keywords— Image Restoration, Super resolution, Hand gesture recognition

I. INTRODUCTION

Image and video restorations are important field of image processing community, whose aim is to estimate the high quality image from low quality image that are noisy and contain blurriness, low resolution. Image processing algorithms are mainly invented to overcome different problems such as image restoration, image segmentation, image enhancement etc. This paper includes review on different Image restoration methods. Image restoration means it is a task that minimizes the degradation that is present in image or recovers an image that is degraded due to presence of noise.

Images that are taken by today's cameras contain some degree of noise and blur. In low lights, blur occur due to camera shake which can damage an image. If the exposure time is decreased to remove blur due to motion in the picture or camera shake, the intensity and colour noise can be increased beyond acceptable level. To achieve visual naturalness, information lost during lossy observation process has to be restored with prior information about natural images. Most Bayesian image restoration algorithms can reconstruct the images by maximizing posterior probability and abstract MAP. The reconstructed images are called the MAP estimates.

Many people use computer either at their work or at home. For easy communication between human and computer some input, output devices are designed over the years. Extensions are done in these input output devices to make the computer more intelligent and allow human to do more difficult communication with the computer. Gesture recognition is one of the extension for input output devices. Gesture recognition allows human to communicate with the machine and interact naturally without using any other devices. By making use of gesture recognition, we can move finger at computer screen so that the cursor will move as the finger moves. Depending on this we can make conventional input devices such as keyboard, mouse and even touch screen redundant. Hand gesture recognition is utilized in this paper for communication between human and machine. The aim of this survey is to restore the degraded image using the hand gesture recognition.

II. LITERATRE SURVEY

Image denoising using new pixon representation based on fuzzy filtering and partial differential equations[1] : For improving the quality of pixonal image, two extensions to pixon-based image modelling has invented. The first extension is using bicubic intepolation and second extension is using fuzzy filtering method. For removing noise from pixonal image, partial differential equations are applied on it. To reduce the different kind of noises and restoring the image, fuzzy filtering and partial differential equation methods are combined. Experimental results indicate that the performance of proposed method is better than the existing pixon based method, PDE's based method, wavelet method and non-local means method.

Coupled Dictionary Training for Image Super-Resolution[2] : The authors have presented a novel coupled dictionary training method for single image super resolution.This single image SR is based on patch wise sparse recovery.By using sparse representation, the learned couple dictionaries can relate the low and high resolution image patch spares. The coupled dictionary training force upon the sparse representation which is derived from the LR image patch can well reconstruct its HR counterpart or HR patch dictionary. This algorithm improves the recovery accuracy and at the same time it can remove the recovery artifacts. In single image SR via sparse recovery, the signals of low resolution image

patches from an observation space and the signals of HR image patches from a latent space. In this paper, the authors have proposed a model for mapping between these two spaces by coupled dictionary learning. It uses the learnt dictionaries for recovering HR patch for any low resolution patch. Two directions are used for improving efficiency and speed up algorithm. 1) Selectively process LR image patches based on natural image statistics. 2) Learn a neural network model for fast sparse representation inference. Image patches can be process adaptively based on standard deviation thresholding and employ a neural network for fast approximation inference.

Generative Bayesian Image Super Resolution with natural image prior[3] : A Bayesian super resolution algorithm is proposed in this paper with natural image statistics by using generative schemes for high resolution image restoration image estimation through sampling. It exploits the natural image statistics for image SR with using flexible high order Markov Random Feild model. Field-of-expert model is used to learn the prior model from natural images. The authors have proposed a fully Bayesian approach, that associates a prior knowledge on hidden high resolution image as well as the noise level into the framework in natural ways. High order MRF model is used for capturing the high resolution image statistics without using priors and for modelling the natural image statistics also enables generative sampling. The Bayesian minimum mean square error (MMSE) criteria is utilized to form approximation of HR image. This MMSE technique does not require ad-hoc modification for achieving desirable restoration performance. To obtain MMSE solution, the markov chain monte carlo based sampling algorithm is used. They have used a probabilistic modelling for performing a posterior mean estimation. MMSE criteria is less sensitive for the local minima in the solution space than the MAP. Experimental tests shows that the proposed method can generate better results than the state of the art SR algorithms.

Image Restoration by Matching Gradient Distributions[4] : For matching the gradient distribution, an iterative deconvolution algorithm is developed. For deconvolution and texture synthesis, this algorithm bridges the energy minimization methods. The key idea is to match the reconstructed image gradient distribution to the desired distribution. For maximization of the observation likelihood they find the images which lies on the manifold of solution with desired gradient distribution. Two approaches are proposed in this paper. First approach penalizes the gradients depending on the Kullback-Leibler (KL) divergence between desired and empirical distribution. But this approach cannot find appropriate solution with gradient distribution significantly from desired distribution. Second approach overcomes the disadvantages of 1st approach by using cumulative penalty function which pushes the parameterized empirical distribution toward the desired distribution. Resulted image contain a gradient distribution that nearly matches the desired distribution.Their study says that by matching the derivative distribution we can improve the quality of reconstructed images. The lower the PSNR/SSIM , the more the improvement in image quality assessment need to do.

Causes and subjective evaluation of blurriness in video frames[5] : Francesca Dardi , LeonardoAbate , JeroenStessen , GiovanniRamponi assessed the blurriness artifacts that are present in video frames. As per the stages of video chains different types of artifacts are identified which may contain blur produced during acquisition, post-processing an decoding. For restoration purpose, all these types are applied on frame to observe the effects of these types on frame. Due to this we can select appropriate technique for restoration. Two metrics are defined which is used for enabling the detection and measuring the encoded blur, discriminated from the native blur which is originated in acquisition. Segmentation algorithm is used which is based on visual attention model for distinguishing between part of blurriness on whole frame and the intentional blur of the background. Experimental test proves that it has the ability to clarify different types of artifacts and also the correspondence between metric values and judgements of human observation. Effectiveness of these metrics are tested mainly against subjective judgements.

Image and Video Restorations via Nonlocal Kernel Regression[6]: In this paper the authors have proposed a non-local kernel regression model for image and video restoration. This model combines the non-local self-similarity and local structural regularity properties for reliable and robust estimation of natural images. The proposed method perform image and video deblurring, denoising and super-resolution work on images. Local structural regularity is used for observing the patches of images that has regular structures where exact judgement of pixel values through regression is possible The non-local self-similarity is mainly based on the observation of image patch that can repeat themselves in images and videos.

Group-Based Sparse Representation for Image Restoration[7] : A Group-Based Sparse Representation (GSR) framework is proposed. Instead of using patch as a public unit they exploited the concept of group as a basic unit of sparse representation which is a combination of nonlocal patches which has similar structure. The proposed GSR modelling contain three folds. The first fold represent the natural images sparsely in domain of group which characterizes the non-local self-similarity and intrinsic local sparsity of images simultaneously in a unified framework. In second fold, rather than using dictionary learning from natural images, an adaptive group dictionary learning method is designed with low complexity. In third fold, for solving the Group-Based Sparse Representation driven l_0 minimization problem for image restoration, split bregman based iterative algorithm is proposed. The study asgaruntees that the feasibility of using l_0 minimization for image restoration problem as well as the perfection of l_0 minimization over the l_1 minimization. Experimental results on image deblurring, image inpainting and image compressive sensing recovery clear that the GSR modelling performs many state of the art schemes in both peak signal to noise ration and visual perception.

Real-Time Hand Gesture Detection and Recognition Using Bag-of-Features and Support Vector Machine Techniques[8] : A real time system is presented for interacting with application through hand gesture. Real time system consists of three modules. 1. Hand detection and tracking. 2. Posture recognition. 3. Grammar. Hand detection and tracking is done by using face subtraction, skin detection and contour comparison algorithm. Posture recognition is done using bag-of-features and multiclass SVM. For observing scale of detected hand posture, its movement direction and transitions between postures, the grammar generates a large number of gesture commands. In training stage, the scale invariance feature transform (SIFT) is used for extracting key point for training images. Once the extraction is done, vector quantization technique is used for mapping the keypoints from training images into a unified dimensional histogram vector (bag-of-words) after kmeans clustering. To build the training classifier, histogram is used as a input vector for multiclass SVM. In testing stage, for each frame captured through webcam, the hand is detected using their algorithm. For every small image the keypoints are extracted which contain the detected hand gesture only and fed it into the cluster model for mapping them into the bag of words vector. And finally it fed into the multiclass SVM training classifier for recognizing hand gesture.

A Real-Time Hand Gesture Recognition System for Daily Information Retrieval from Internet[9]: The authors have proposed the system design that can get daily information from internet through hand movements. For recognition of hand gesture, they have used skin color detection by yCbCr spaces and camshaft for tracking. Hand gesture method have used PCA method. The skin detection method detects the region and position of hand from input image. It keeps on detecting the skin region until the condition of tracking trigger is enough. If the tracking trigger condition is enough it will start to track by camshift algorithm. After applying camshaft algorithm, segmentation and normalization is done, then PCA is used.

Real Time Gesture Recognition System for Interaction in Dynamic Environment[10] : A hand gesture recognition system is developed in this paper for interacting with a human and computer in dynamic environment.Image Processing techniques are used in gesture recognition system such as detection, segmentation, tracking and recognition of hand gestures for translating it to a meaningful command. The gesture recognition system is designed for both static and dynamic hand gesture recognition. For locating hand positions and classifying gestures, the haar cascade classifier is used which digitize images for analysing images in object recognition application. Camshift technique is used for tracking of hand with shifting region/area of interest with average shift in the object of interest that is hand. After tracking of hand, contour is mapped with hand for extracting a convex hull. Recognition is done depends on number of defects formed in it. After tracking number of defects generated by hand , it maps it to a meaningful command.

Real-time Hand Gestures System for Mobile Robots Control[11] : Real time hand gesture recognition system is developed for mobile robot controlling through hand gesture ahead of a static camera. System contains image pre-processing and feature of extraction states which consists of bounding box and center-of-mass based computations. For gesture sign control, the object's center-of-mass and bounding box attributes are extracted through feature of extraction state. For facilitating the identification process of hand gesture a glove based technique through colour filtering is used and eliminating undesired objects was also used. Mobile robot can be controlled using hand gesture system with the properties of center of gravity for identifying the distance of center of the object to the index finger for indicating the direction the robot should moves. The experimental tests proves that the robot can successfully move to front, backward, left, right & stop through hand gestures inputs given by user.

Real-time fingertip localization conditioned on hand gesture classification[12] : A method is proposed in this for obtaining exact hand gesture classification and fingertip localization from depth images. For globally describing hand poses and to detect fingertip positions locally, a oriental radial distribution (ORD) feature is used. ORD feature is exploited into two folds. In first fold, for classification purpose it uses ORD to describe hand gesture globally. In second for detecting hands and fingertip locations robustly, multiscale local description is utilized. They has proposed a method to infer fingertip locations including hand gestures as an auxiliary variable for obtaining fingertip on a search space of a obtained hand gesture. For experimental test on gesture recognition they used ASL dataset which is available publically as well as their own dataset of hand gesture. The result of test proves that Oriental Radial Distribution is more effective than 3D features for classification tasks. The ColorTip dataset has proposed for fingertip localization and hand gesture recognition.

Hand Gesture Recognition using an Android Device[13] : The aim of this paper is to recognize 40 basic hand gestures. It contain features such as centroid in the hand, thumb presence and number of peaks in hand gesture. The algorithm used in this is based on shape based features. Among backpropogation algorithm, artificial neural network is used for recognition purpose. Android camera is used for acquisition of image, using this camera frames are acquired and send to the server and edge detection of video is done using thinning which is used for decreasing noise, and from these thinning images tokens are created after tokens are fetched. Sobel edge detector algorithm is used in this for detecting edges of an image. This application is mainly useful for communicating with deaf person. Sign gesture are stored in system database of size 176*144 pixels so that less time and memory space is required during pattern recognition. The gesture recognition rate is between 70-80%. Accuracy of system is 77%.

Real-time Multi-Objective Hand Posture/Gesture Recognition by Using Distance Classifiers and Finite State Machine for Virtual Mouse Operations[14] : In this paper the authors have developed a virtual mouse system that has pre-defined mouse movements that we can recognize in real time without any context. The real time hand recognition system is divided into three steps. First is skin detection, second is feature extraction and third is recognition. For hand region detection some methods are used and these are morphological operations that is used for enhancement, YCbCr color space, polygonal approximation and contour finding. For hand posture recognition, distance classifier method is used and for the hand gesture , finite state machine method is used. In this paper simple polygons of hand postures are constructed and they are recognized by using distance classifiers. Once the structure of hand posture is extracted, the comparison of structures is done between real time taken image and earlier posture images. This comparison is based on the similarity of structures. The posture that has best similarity measure is selected as a mouse action for controlling the cursor of the computer system.

III. COMPARISION OF DIFFERENT RESTORING TECHNIQUES

METHOD	ACCURACY	PURPOSE
Partial Differential Equations and fuzzy filtering[1]	Medium	Denoise
Coupled Dictionary Training	High	Super Resolution
Bayesian Super Resolution	Medium	Super Resolution
Matching Gradient Distribution	Medium	Improve quality
Non Local Kernel Regression	High	Deblurring, Denoising, Super Resolution
Group Based Sparse Representation	High	Deblurring, Inpainting, Image compression sensing recovery

IV. CONCLUSIONS

As per the above analysis we can see that fuzzy filtering and partial differetial equation, bayesian super resolution are not having high accuracy for denosing and super resolution. The coupled dictionary training is good for super resolution but not robust for blur and denoising purpose. With the help of matching gradient distribution we can only improve quality of images. Non local kernel regression has high accurcy for image dedblurring, denoising and super resolution. So for our method non local kernel regression is moreappropriate than other methods. The survey on hand gesture recognition contain many methods but we are going to use distance classifier and finite state machine for virtual mouse operations.

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