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Research Issues on Digital Image Processing For Various Applications in this World

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ABSTRACT

Digital image processing is the manipulation of the numeric data of the digital image for enhancing it to make it suitable for the further processing according to the specific application needs. Today, Image Processing systems are very popular due to easy availability of powerful computers, large size memory devices, graphics software etc. By doing image processing, corrupted pictures can be enhanced, medical images clarified, and satellite photographs improved. Image Processing is a technique to enhance raw images received from cameras/sensors placed on satellites, space and aircrafts or pictures taken in normal day-to-day life for various applications.

Keywords: Digital Image processing, Neural Network, Noise, DWT, Image restoration.

1. INTRODUCTION

An adaptive varying window size Recursive Weighted Median Filter [ARWMF] for removing the impulse noise in Color images is presented. The weights for the RWMF are calculated by using the Median controlled algorithm. The computational complexity for the weight calculation is simple and it is very efficient. In median controlled algorithm, the filter gives the smallest weight for the impulse. However, for many weight functions, including the exponential one, this weight is non-zero. Thus the impulse has an effect on the output and the magnitude of the impulse is reduced. The window size of the RWMF is adaptive based on the presence of noise density. The performance of the proposed algorithm is given in terms of mean square error (MSE), Mean Absolute Error (MAE) and Peak Signal to Noise Ratio (PSNR) and it is compared with Standard Median filters, Weighted Median filters, Center Weighted Median filters, Recursive Weighted Median filters and Adaptive length Recursive weighted median filters using Median Controlled Algorithm.

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2. IMAGE FILTERING TECHNIQUE

In the Transmission of images over channels, Images are corrupted by salt and pepper noise, due to faulty communications. Salt and Pepper noise is also referred to as Impulse noise. The objective of filtering is to remove the impulses so that the noise free image is fully recovered with minimum signal distortion. The best-known and most widely used nonlinear digital filters, based on order statistics are median filters. Median filters are known for their capability to remove impulse noise without damaging the edges. Median filters are known for their capability to remove impulse noise as well as preserve the edges. The effective removal of impulse often leads to images with blurred and distorted features. Ideally, the filtering should be applied only to corrupted pixels while leaving uncorrupted pixels intact. Applying median filter unconditionally across the entire image as practiced in the conventional schemes would inevitably alter the intensities and remove the signal details of uncorrupted pixels. Therefore, a noise-detection process to discriminate between uncorrupted pixels and the corrupted pixels prior to applying nonlinear filtering is highly desirable. Adaptive Median is a "decision-based" or "switching" filter that first identifies possible noisy pixels and then replaces them using the median filter or its variants, while leaving all other pixels unchanged. This filter is good at detecting noise even at a high noise level. The adaptive structure of this filter ensures that most of the impulse noises are detected even at a high noise level provided that the Window size is large enough. The existing nonlinear filter like Standard Median Filter (SMF), Adaptive Median Filter (AMF), Decision Based Algorithm (DBA) and Robust Estimation Algorithm (REA) shows better results at low and medium noise densities. At high noise densities, their performance is poor.

3. DEFINITION OF IMAGE

An image may be defined as a two-dimensional function, f(x, y), where x and y are spatial (plane) coordinates, and the amplitude of at any pair of coordinates (x, y) is called the intensity or gray level of the image at that point. When x, y, and the amplitude values of f are all finite, discrete quantities, we call the image a digital image. The field of digital image processing refers to processing digital images by means of a digital computer.

4. MEDICAL IMAGE PROCESSING

Automatic speech recognition is an essential component in many computer interaction systems have reached high performance levels for condition controlled environments audio visual automatic speech recognition concerning visual feature extraction and audio visual integration to reduce the video lectures to detect and tracking recognition of Lip/Mouth combined with traditional image processing. Magnetic Resonance Imaging is safest among radiological technique is used. A technique for retrieving synthetic noisy 2-D MR images of single subject with semantic regions. T1, T2, PD Modalities are used and each modality contains images of coronal view, sagittial view, transversal view for multiple subjects. Brain tumors include all tumors inside the central epithelial duct. Based on the central epithelial duct to be created by associate degree abnormal and uncontrolled organic process within the brain, in lymphatic tissue, blood vessels, within the borne nerves.

5. CLASSIFICATION OF FILTERS

All quality of scanned image is increased, so morphological operators are applied to the tumor within the scanned image. Noise can be introduced into images during acquisition and transmission. Two common types of impulse noise are salt, pepper and random valued noise. Filtering is categorized into linear and non linear filter. Linear filter could produce very high blurring effect. The nonlinear filters have been utilized because of improved performance removal of impulse noise. The centre weighted and weighted median filter are improved version of median filter. The centre weighted median filter which provides weights to the centre pixel for filtering process. The weighted median filtering provides weights to control the filtering process which preserves image details. In multi state median filter, the output of the filter is adaptively switched among those of a set of CWM filter having different center weights. The zero mean property of the distribution allows such noise to be removed by locally averaging pixel values.

MRIC (Magnetic Resonance Imaging) and PET (Positrons Emission Tomography) medical image fusion has important clinical significance. PET image shows the brain function with a low spatial resolution. MRI image shows the brain tissue anatomy and contains no functional information. Fused image contains both functional information and more spatial characteristics with no spatial and color distortion.

Gabor filters, which exhibits desirable characteristics of spatial locality and orientation selectively and are optimally localized in the space and frequency domains, have been extensively and successfully used in face recognition.

- All the images (time vs amplitude) acquired by camera unit is in spatial domain mode.
- The Fourier transform is used to convert the spatial domain mode into frequency domain mode.
- Recognition of facial image, we need the image in Multi resolution Mode. (Frequency vs time)
- For this multi resolution mode, we use Gabor wavelet transform instead of Fourier transform

6. APPLICATION OF WAVELET BASED METHODS

- Wavelets as edge detectors.
- Using wavelets to separate targets from cluster based on scale differences.
- Using wavelets as approximate matched filters.
- Capturing target dynamic range differences using wavelet filters.

7. IMAGE FUSION

Image fusion is the process of combining relevant information from two (or) more images into single image. In pixel image level fusion, the input images are fused pixel by pixel followed by the information extraction. In Feature level fusion, the information is extracted from each input image separately and then fused based on features from input images. In decision level fusion, the information is extracted from each input image separately and then decision is made for each input channel. The weighted median filter that uses weights to contrast the filtering behavior preserves features of given shapes and size. The center weighted median filter only the weights of center pixel of the filtering window. The image captured by different sensors are combined into a single image which retains the important features of the images from the individual sensors is known as image fusion.

8. DISCRETE WAVELET TRANSFORM

Discrete Wavelet Transform provides a framework in which a signal is decomposed, with each level corresponding to lower frequency sub band and also higher frequency sub bands. Peak signal to noise ratio is a metric for the ratio between the maximum possible power of a signal and power of corrupting noise that affects the fidelity of its representation.

The Root mean square error for the reference image and fused image. The quality factor between the source image and fused image. The extension of discrete wavelet transform is discrete wavelet packet transform in which we split both low pass and high pass filters at all scales in filter bank implementation to obtain flexible and detail analysis transform for denoising the sound signals.

Wavelet packet method has been used to reduce the additive white Gaussian noise from the speech signal for SNR improvement. Compression is very essential tool for achieving image data, image data transfer on the network.

They are various techniques available for lossy and lossless compression. Wavelet based compression techniques are used for higher compression ratios with minimal loss of data.

For many natural images, the wavelet transform is a more effective tool than the Fourier transform. The wavelet transform provides a multi-resolution representation using a set of analyzing functions that are dilations and translations of a few functions (wavelets). The wavelet transform comes in several forms. The critically-sampled form of the wavelet transform provides the most compact representation; however, it has several limitations. For example, it lacks the shift-invariance property, and in multiple dimensions it does a poor job of distinguishing orientations, which is important in image processing. For these reasons, it turns out that for some applications improvements can be obtained by using an expansive wavelet transform in place of a critically sampled one. An expansive transform is one that converts an N-point signal into M coefficients with $M > N$. There are several kinds of expansive DWTs; here we describe and provide an implementation of the 2 dimensional discrete wavelet.

The Discrete Wavelet Transform (DWT), which is based on sub-band coding, is establishing to yield a fast computation of Wavelet Transform. It is simple to implement and reduces the computation time and resources required. Wavelets can be realized by means of iteration of filters by way of rescaling. In the discrete wavelet transform (DWT), the image is passed through a sequence of low pass filters to examine the low frequency components, and a series of high-pass filters to explore the high frequency components. The resolution of the image is considered by the amount of detailed information in the image which is changed by the filtering operation, and the scale is altered by the up-sampling or down-sampling operations. After passing the image through a half band low-pass filter, half of the samples can be eliminated. Therefore, the resolution is halved once the filtering operation is completed. The DWT analyze the image at different frequency bands with different resolutions by

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decomposing the image into an approximation and detail information. The discrete wavelet transform proposed by Mallat (1989) initially decomposes an image into one approximation image and three detail images. It filters the original image with complementary low-pass and high-pass filters in every dimension. The filtered images are down-sampled at all other pixel, produce four images of half the resolution of the original. One-level wavelet transform produces an approximation sub-image and three detail sub-images. The approximation sub-image maintains as same as the original image, while the detail sub-images represent the difference between the approximation sub-image and the original image in different directions. The process of wavelet decomposition can also be described as a filter convolution with the original image.

9. IMAGE RESTORATION

Image restoration is an inevitable component in the digital image processing. It is a preprocessing technique that reduces (or) eliminates the noise and blur in an image. Noise is undesired (or) irrelevant information which degrade the quality of image due to the limitations in image acquisition and transmission. Digital image are contaminated by impulse during acquisition (or) transmission.

10. FACE RECOGNITION

Face recognition has attracted much attention due to its potential value for applications and its theoretical challenges. In real world, the face images are usually affected by different expressions, poses, occlusions and illuminations and the difference of face images from the same person could be larger than those from different ones. Therefore, how to extract robust and discriminate features which make the intrapersonal faces compact and enlarge the margin among different persons becomes a critical and difficult problem in face recognition.

Face recognition is a visual pattern recognition problem. Face recognition system with the input of an arbitrary image will search in database to output people's identification in the input image. A face recognition system generally consists of four modules as detection, alignment, feature extraction and matching, where localization and normalization (face detection and alignment) are processing steps before face recognition (facial feature extraction and matching) is performed.

Automatic face analysis which includes face detection, face recognition and facial expression recognition has become a very active topic in computer vision research. Principle component analysis is a linear projection method to reduce the number of parameters of an image under processing. It transfers a set of correlated variables into a new set of uncorrelated variables and maps into a space of lower dimensionality. It is a form of unsupervised learning. It can be viewed as a rotation of the existing axes to new positions in the space defined by original variables. New axes are orthogonal and represent the directions with maximum variability.

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11. PREPROCESSING

- The quantity of training data grows exponentially with the dimension of the input space.
- We have only limited quantity of input data.
- Increasing the dimensionality of the problem leads to give a poor representation of the mapping.

Inputs of the neural net are often of different types with different orders of magnitude (Pressure, Temperature etc..,). It is necessary to normalize the data so that they have the impact on the model. Translate input values so that they can be exploitable by the neural network and reduce the variables.

Sometimes, the number of inputs is too large to be exploited, therefore reduction of the input number simplifies the construction of the model is also called as component reduction. The main goal of component reduction is better representation of the data in order to get a synthetic view without losing relevant information.

12. VARIOUS TYPES OF NOISE

Gaussian noise is statistical noise that has a probability density function of the normal distribution (also known as Gaussian distribution). In other words, the values that the noise can take on are Gaussian-distributed. It is most commonly used as additive white noise to yield additive white Gaussian noise (AWGN).

Photon noise, also known as Poisson noise, is a basic form of uncertainty associated with the measurement of light, inherent to the quantized nature of light and the independence of photon detections. Its expected magnitude is signal dependent and constitutes the dominant source of image noise except in low-light conditions.

It represents itself as randomly occurring white and black pixels. An effective noise reduction method for this type of noise involves the usage of a median filter. Salt and pepper noise creeps into images in situations where quick transients, such as faulty switching, take place. The image after distortion from salt and pepper noise looks like the image attached. There are different types of impulse noise namely salt and pepper type of noise and random valued impulse noise. In salt and pepper type of noise the noisy pixels takes either salt value (gray level 225) or pepper value (grey level 0) and it appears as black and white spots on the images.

The dominant noise in the lighter parts of an image from an image sensor is typically that caused by statistical quantum fluctuations, that is, variation in the number of photons sensed at a given exposure level. This noise is known as photon shot noise. Shot noise has a root-mean-square value proportional to the square root of the image intensity, and the noises at different pixels are independent of one another. Shot noise follows a Poisson distribution, which is usually not very different from Gaussian. In addition to photon shot noise, there can be additional shot noise from the dark leakage current in the image sensor; this noise is sometimes known as "dark shot noise "or "dark-current shot noise". Dark current is greatest at "hot pixels" within the image sensor. The variable dark charge of normal and hot pixels can be subtracted off (using "dark frame subtraction"), leaving only the shot noise, or random component, of the leakage. If dark-frame subtraction is not done, or if the exposure time is long enough that the hot pixel charge exceeds the linear charge capacity, the noise will be more

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The noise caused by quantizing the pixels of a sensed image to a number of discrete levels is known as quantization noise. It has an approximately uniform distribution. Though it can be signal dependent, it will be signal independent if other noise sources are big enough to cause dithering, or if dithering is explicitly applied.

13. FEATURE EXTRACTION

Feature extraction involves simplifying the amount of resources required to describe a large set of data accurately. When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant (much data, but not much information) then the input data will be transformed into a reduced representation set of features. Transforming the input data into a set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the feature set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input.

When performing analysis of complex data, one of the major problems stems from the number of variables involved. Analysis with a large number of variables generally requires a large amount of memory and computation power or a classification algorithm which over fits the training sample and generalizes poorly to new samples. Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy. Since image data are by nature very high dimensional, feature extraction is often necessary step for classification to be successful. Besides lowering the computational cost, feature extraction is also a means for simplifying classification problems.

The purpose of feature extraction is to reduce the original data set by measuring certain properties or features that distinguish one input pattern from another. The extracted features provide the characteristics of the input type to the classifier by considering the description of the relevant properties of the image into feature space.

14. NEURAL NETWORK

An artificial neural network, often just called a neural network, is a mathematical model inspired by biological neural networks. A neural network consists of an interconnected group of artificial neurons, and it processes information using a connectionist approach to computation. In most cases a neural network is an adaptive system that changes its structure during a learning phase. Neural networks are used to model complex relationships between inputs and outputs or to find patterns in data. Neural network models in artificial intelligence are usually referred to as artificial neural networks (ANNs); these are essentially simple mathematical models defining a function $f:X \quad Y$ or a distribution over X or both X and Y, but sometimes models are also intimately associated with a particular learning algorithm or learning rule. A common use of the phrase ANN model really means the definition of a class of such functions (where members of the class are obtained by varying parameters, connection weights, or specifics of the architecture such as the number of neurons or their connectivity).

Classification is a data mining (machine learning) technique used to predict group membership for data instances. To simplify the problems of prediction or classification, neural networks are being introduced. Neural networks are simplified models of the biological neuron system. It is a massively parallel distributed processing system made up

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of highly interconnected neural computing elements that have the ability to learn and thereby acquire knowledge and make it available for use. Various learning mechanisms exist to enable the NN acquire knowledge.

NN architectures have been classified into various types based on their learning mechanisms and other features. This learning process is referred to as training and the ability to solve a problem using the knowledge acquired as inference. NNs are simplified imitations of the central nervous system, and therefore, have been inspired by the kind of computing performed by the human brain. The structural constituents of a human brain termed neurons are the entities, which perform computations such as cognition, logical inference, pattern recognition and so on. Hence the technology, which has been built on a simplified imitation of computing by neurons of a brain, has been termed Artificial Neural Systems (ANS) technology or Artificial Neural Networks (ANN) or simply neural networks. Other names for this technology are Connectionist Networks, Neuro Computers, and Parallel Distributed Processors etc. Also, neurons are can also be referred to as neuroses, Processing Elements (PEs), and nodes.

Back propagation is a common method for training artificial neural networks. It is a supervised learning network, and is a simplification of the delta rule. Back propagation requires the activation function used by the artificial neurons (or nodes) be differentiable. The data in the network flow from the input layer to the output layer crossing the intermediate layers (called hidden layers) without feedbacks, then the network is called “feed forward”. This type of neural network has been widely used in supervised image classification of remotely sensed data. It requires dataset of the desired output for many inputs, for making the training set. The back propagation algorithm trains a network for a given set of input patterns with known classifications. When each entry of the sample input pattern is presented to the network, the network examines the output response to the sample input pattern. The output response is then compared with the known and desired output and the error value is calculated. Based on the error value, the connection weights are adjusted. During the training phase, training data is fed into the input layer and it propagates to the hidden layer and then to the output layer is known as the forward pass. In forward pass, each node in hidden layer gets input from the input layers, which are multiply with appropriate weights and then added. The output of the hidden node is the non-linear transformation of the resulting sum. In the same way each node in output layer gets input from hidden layer, which are multiplied with suitable weights and then added. The output of this node is the non-linear transformation of the ensuing sum. Output values from the output layer are compared with the target output value. The target output values are those that attempt to train our network. The error between actual output values and target output values is calculated and propagated back to hidden layer. This is called the backward pass. The error is used to update the connection strength between nodes, as weight matrices between input-hidden layers and hidden-output layers are updated. During the testing phase, learning does not layer and the feed forward of the testing data is similar to the training data takes place because of no change in the weight matrices. Each test vector is fed into the input

15. CONCLUSION

Most of the image-processing applications involve denoising as one of its most widely used image restoration concepts. The purpose of image denoising is to restore the original image details as much as possible by removing the unwanted noise. Digital image is susceptible to a variety of noise, which affects the image quality. In recent years a lot of research works in digital image processing using medical applications and also neural network. The quality of the image will be done by new algorithm design to apply the image processing application.

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(Scholarly Peer Review Publishing System)

16. REFERENCES

[1] R. C. Gonzalez and R. E. Woods, Digital Image Processing. Englewood Cliffs, NJ: Prentice-Hall, 2002.

[2] Raymond H.Chan,Chung Wa Ho, "Salt and Pepper noise removal by Median type noise detectors and detail preserving regularization, IEEE Trans. Image process, vol.14,oct 2005.

[3] J.Astola and P.Kuosmaneen, Fundamentals of Nonlinear Digital Filtering. Boca Raton, FL:CRC,1997. [4]. V.R.Vijay Kumar,S.Manikandan, "High density Impulse noise removal in color images using Median controlled Adaptive Recursive Weighted Median filter", IAENG International journal of computer science,34:1, 15 Aug 2007.

[4] G. Arce, A General Weighted Median Filter Structure Admitting Negative Weights, IEEE Tr. On Signal Proc., vol.46, Dec. 1998.

[5] G. Arce and J. Paredes, Recursive Weighted Median Filters Admitting Negative Weights and Their Optimization, IEEE Tr.on Signal Proc., vol.48, nr. 3, March 2000.

[6] X.Bresson, T.F.Chan, "Fast dual minimization of the Vectorial total variation norm and applications to color image processing", revised version oct 2008.

[7] Ayyan Hussain, Arfan Jaffar, "Directional Weighted Median based Fuzzy filter for Random valued Impulse Noise removal, ICIC International,2010.

[8] R. Garnett, T. Huegerich, C. Chui, and W. J. He, "A universal noise removal algorithm with an impulse detector," IEEE Trans. Image Process., vol. 14, no. 11, pp. 1747–1754, Nov. 2005.

[9] D. Brownrigg, "The weighted median filter," Commun. ACM, vol. 27, no. 8, pp. 807–818, Aug. 1984.

[10] K.Vasanth, S.Karthik, Sindu Dhivakaran, Removal of salt and pepper noise using Unsymmetrical Trimmed Variants as detector, European Journal of Scientific Research ISSN 1450-216X Vol.70 No.3 (2012), pp. 468-478,Euro Journals Publishing, Inc.2012.

[11] K. Aiswarya, V. Jayaraj, and D. Ebenezer, A new and efficient algorithmfor the removal of high density salt and pepper noise in images and videos, in Second Int. Conf. Computer Modeling and Simulation,2010, pp. 409–413.

[12] S. Esakkirajan, T. Veerakumar, Adabala, N. Subramanyan, C.H. Premchand, Removal of high density salt and pepper noise through Modified Decision Based Unsymmetric Trimmed Median Filter, IEEE signal processing letters vol.18,no.5,may 2011.

GLOBAL JOURNAL OF ADVANCED RESEARCH
(Scholarly Peer Review Publishing System)

[13] Jon Atli Benediktsson, Martino Pesaresi, and Kolbeinn Arnason,"Classifiication and Feature Extraction for Remote Sensing Images From Urban Areas Based on Morphological Transformations", IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING, VOL. 41, NO. 9, SEPTEMBER 2003.

[14] Seyfallah Bouraoui," A System to Detect Residential Area in Multispectral Satellite Images", IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 6, No 2, November 2011 ISSN (Online): 1694-0814.

[15] Xin Huang, Liangpei Zhang, and Pingxiang Li," Classification and Extraction of Spatial Features in Urban Areas Using High-Resolution Multispectral Imagery", IEEE GEOSCIENCE AND REMOTE SENSING LETTERS, VOL. 4, NO. 2, APRIL 2007.

[16] Saroj K. Meher, B. Uma Shankar, and Ashish Ghosh,"Wavelet-Feature-Based Classifiers for Multispectral Remote-Sensing Images", IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING, VOL. 45, NO. 6, JUNE 2007.