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Image Fusion Using Self Organizing Feature Map With Histogram Equalization

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ABSTRACT

The images are fused based on self organizing feature map (SOFM) with histogram equalization. The existing technique for image fusion involves direct operation on pixels or segments but they fail to produce quality fused images and are mostly dependent on the application they use. The existing segmentation algorithms cannot be used because of the complexity and time consumption it takes when various images are fused. The proposed system of segmentation of images using SOFM with histogram equalization involves segmenting of gay scale images. The self organizing feature map with histogram equalization produces numerous slices of the source and reference images based on multiple combinations of gray scale and fused together dynamically based on the application it is being used.

KEYWORDS: Image Fusion, Self Organizing Feature Maps, Gray Scale Images, Histogram equalization

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INTRODUCTION

Image fusion is the technique that incorporates two or more images of a place into a single composite image that is more informative and is more suitable for visual interpretation or computer operations.[1] The purpose of image fusion is to reduce unpredictable nature and minimize excessive output while maximizing original information by focusing on the application. Image fusion has become a standard term used among medical oncology and treatment.[3] Image fusion algorithms will be categorised into element, feature and symbolic levels. Pixel-level algorithms work either within the abstraction domain or within the rework domain.[9] Although pixel-level fusion may be a native operation, transform domain algorithms create the fused image globally.[11] The discrete wavelet transform (DWT) has been employed in several applications to fuse pictures. [6, 7, 8] Feature-based algorithms typically segment the images into regions and fuse the regions using their various properties recently methods have been proposed to fuse multifocus source images using the divided blocks or segmented regions instead of single pixels.[10] Most of the standard image fusion ways are supported the idea that the supply pictures are noise free, and they can produce good performance when the assumption is satisfied[2]. For the standard clanging image fusion ways, they usually denoise the source images, and then the denoised images are fused. [4, 5] Further in any region primarily based fusion algorithmic rule, the fusion results are affected by the performance of segmentation algorithm. The various segmentation algorithms are based on thresholding and clustering but the partition criteria used by these algorithms often generates undesired segmented regions.[12] In order to overcome the above said problems a new method for segmentation using Self-organizing Feature Maps which consequently helps in fusion of images dynamically to the desired degree of information retrieval depending on the application has been proposed in this paper. The projected algorithmic rule is compatible for any form of image either clanging or clean. The method is straightforward and since mapping of image is allotted by Self-organizing Feature Maps all the data within the pictures are preserved. The images employed in image fusion ought to already be registered. A novel image fusion algorithm based on self organizing feature map with histogram equalization is proposed in this paper.

SELF-ORGANIZING FEATURE MAP

A self-organizing map (SOFM) may be a style of artificial neural network that uses unsupervised learning to make a two-dimensional map of a drag area. A self-organizing map is additionally referred to as a self-organizing feature map (SOFM) or a Kohonen map. Self-organizing Feature Map (SOFM) may be a special category of Artificial Neural Network supported competitive learning. It's an original Artificial Neural Network designed around a one or two-dimensional lattice of neurons for capturing the necessary options contained within the input. The Kohonen technique creates a network that stores info in such how that any topological relationships among the coaching set square measure maintained. Additionally to clump the information into distinct regions, regions of comparable properties square measure place into sensible use by the Kohonen maps. The first profit is that the network learns autonomously while not the necessity that the system be outlined. System doesn't stop learning however instead continues to adapt to ever-changing inputs. This physical property permits it to adapt because the surroundings changes. A selected advantage over alternative artificial neural networks is that the system seems similar temperament to parallel computation. So the sole international data needed by every vegetative cell is that the current input to the network and therefore the position among the array of the vegetative cell that made the utmost output a self-organizing Feature Map doesn't would like a target output to be nominal not like several alternative sorts of network. Instead, wherever the node weights match the input vector, that space of the lattice is by selection optimized to a lot of closely gibe the information for the category, the input vector may be a member. From an initial distribution of random weights, and over several iterations, the self-organizing feature map eventually settles into a map of stable zones. Every zone is effectively a feature classifier. The output may be a style of feature map of the input area. Within the trained network, the blocks of comparable values represent the individual zones. Any new, antecedently unseen input vectors given to the network can stimulate nodes within the zone with similar weight vectors. Coaching happens in many steps and over a lot of iteration. Every node's weights square measure initialized. A vector is chosen randomly from the set of coaching information and given to the lattice. Each node is examined to calculate that one's weights square measure most just like the input vector. The winning node is often referred to as the most effective Matching Unit (BMU). The radius of the neighbourhood of the most effective Matching Unit is currently calculated. This can be a worth that starts massive, usually set to the 'radius' of the lattice, however diminishes every time-step. Any nodes found among this radius square measure deemed to be within the most effective Matching Unit‘s neighbourhood. Every close node's weights square measure adjusted to create them a lot of just like the input vector. The nearer a node is to the Best Matching Unit; a lot of its weights get altered. The procedure is perennial for all input vectors for range of iterations. Before coaching, every node's weights should be initialized. Usually these are set to small-standardized random values. to work out the most effective Matching Unit, one methodology is to retell through all the nodes and calculate the euclidian distance between every node's weight vector and therefore the current input vector. The node with a weight vector nearest to the input vector is labeled because the Best Matching Unit. When the most effective Matching Unit has been determined, successive step is to calculate that of the opposite nodes square measure among the most effective matching unit's neighbourhood. By observing these nodes can have their weight vectors altered within the next step. A singular feature of the Kohonen learning formula is that the world of the neighbourhood shrinks over time to the dimensions of only one node. After knowing the radius, iterations square measure disbursed through all the nodes within the lattice to work out if they lay among the radius or not. If a node is found to be among the neighborhood then its weight vector is adjusted. each node among the most effective Matching Unit‘s neighborhood (including the most effective Matching Unit) has its weight vector adjusted. The SOFM design depicted below in figure.1demonstrates the mapping structure.

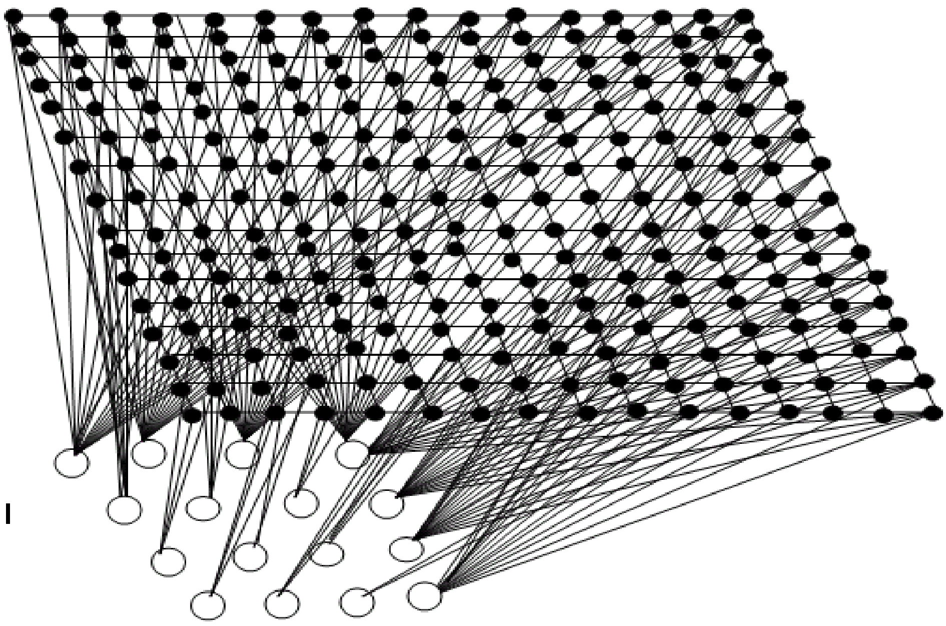

Figure1. SOFM Architecture

HISTOGRAM EQUALIZATION

Histogram Equalization is termed as a technique for adjusting image intensities to enhance the contrast of images. The histogram equalization function, aims to match a flat histogram. This technique allows for areas of decrease in local contrast to gain increase in contrast. This technique accomplishes this by distributing out the most frequent intensity values effectively. The images will be of different types. The distribution of gray levels is limited to only certain ranges. For example in case of medical images like MRI Scan most of the gray levels are between 0 and 100. It is computationally complex and economically not feasible to construct neural networks for every application depending on the data distribution. In such cases most of the neurons in the competitive layer will unnecessarily involve in the self-organization.

Histogram Equalization is carried out in the images before given as input to the Self-organizing Feature Map Network. Existing values will be mapped to new values resulting image with less number of the original number of intensities. Mapping the pixels of the raw image does not introduce new intensities in the image. This results in correlation of the pixels and due to the presence of similar pixel values within the small blocks of images, the radius of neighborhood gets reduced at the start of the training stage itself resulting in quick convergence. Further the frequency of occurrence of gray-levels in the image will be more or less equal or rather uniform by the mapping.

Due to this most of the image blocks will be similar and hence the learning time gets reduced. In the encoding phase, due to correlation of data in the image blocks, the number of indices for the winner neurons will be less. Similarly in the decoding phase since indices are less, the time taken for generation of weights and consequently the time for fusion also gets reduced.

In this neural network since both the weight matrix and the equalized input pattern match with respect to the range of gray-levels, the topology of the input pattern is maintained without much reorganization during the process and hence the reconstruction errors are less and the finer details of the image are preserved. To transform the gray levels of the image so that the histogram of the resulting image is equalized to become a constant:

$$h[i] = \text{constant}, \qquad 0 \leq i < L \tag{1}$$

The purposes:

- to equally make use of all available gray levels in the dynamic range;
- for further histogram specification.

EXPERIMENTAL WORKS AND RESULTS

Five different images data sets are taken for the experimental work. By using SOFM quality fused images are obtained. By the below experimental results the existing methods produced less quality fused images when compared to the proposed method. Fusion time period is gradually reduced when compare to the existing methods. Table.1 depicted below shows the experimental results of quality fused images.

Table: 1 SOFM with histogram equalization

Images	PSNR			Time (Seconds)
	Image A	Image B	Fused Image	
Lena	30.3811	31.7014	36.0583	96
MRI -Head	30.7873	33.9012	35.2319	94
Multimodal image	34.4036	27.1648	35.9723	94
Day/Night Image	34.1852	14.4215	36.2592	93
Diagonal Image	34.1854	18.2441	34.7491	93

Image A Image B Fused Image

Lena Image

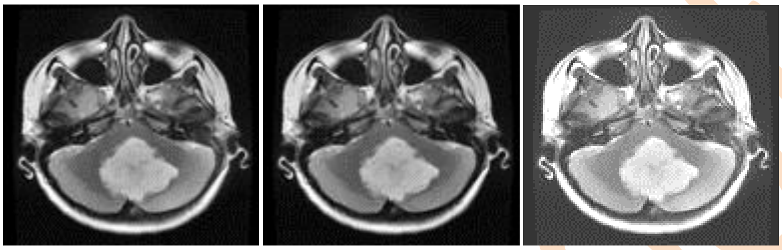

Image A Image B Fused Image

MRI -Head Image

Image A Image B Fused Image

Multimodal image

Image A Image B Fused Image

Day/Night Image

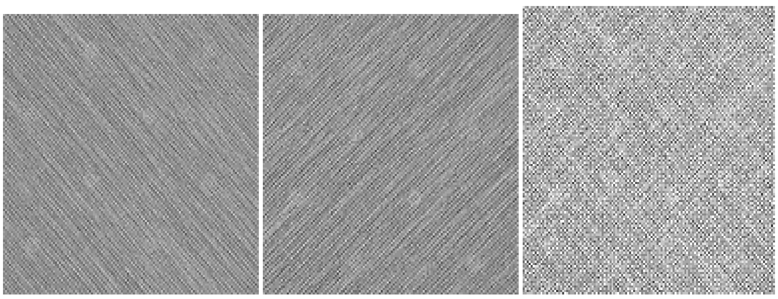

Image A Image B Fused Image

Diagonal Image

CONCLUSION

In this paper, fusion methods adopting Self-Organizing Feature maps with histogram equalization are proposed. The proposed methods are efficient approaches for fusion of gray-scale images. They are compatible and general to any type of gray-scale images. The proposed methods ensure preservation of topography and preservation of original data. The loss in data occurs only in the neural network computation. This computational loss has been reduced by the creation of unique and similar exemplars by the modified approach using histogram equalization. The fusion method adopting Self-Organizing feature map with histogram equalization is unique in the sense that any number of images can be fused until the desired result is achieved.

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