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Medical Image Fusion Based on MRI & CT Synchronized Anisotropic Diffusion Model

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ABSTRACT: This project developed a prototype integrated software system that combines image processing on image fusion. The phase congruency that can provide a contrast and brightness-invariant representation is applied to fuse low-frequency coefficients, whereas the Log-Gabor energy that can efficiently determine the frequency coefficients from the clear and detail parts is employed to fuse the high-frequency coefficients. The proposed fusion method has been compared with the discrete wavelet transform (DWT), the fast discrete curve let transform (FDCT), and the dual tree complex wavelet transform (DTCWT) based image fusion methods and other NSCT-based methods. Visually and quantitatively experimental results indicate that the proposed fusion method can obtain more effective and accurate fusion results of multimodal medical images than other algorithms. Further, the applicability of the proposed method has been testified by carrying out a clinical example on a woman affected with recurrent tumor images. A local Laplacian energy-based fusion rule is proposed for low-pass sub bands. The fused high-pass and low-pass sub bands are inversely transformed to obtain the fused image. In the comparative experiments, three categories of multi-modality medical image pairs are used to verify the effectiveness of this method.

KEYWORDS: Medical Image Fusion, DWT, FDCT, DTCWT, NSCT.

I. INTRODUCTION

Cited from(1-13), As a powerful and fundamental tool, medical imaging plays an irreplaceable role in modern medical diagnosis and treatment. A number of medical imaging modalities, that include positron emission tomography (PET), computed tomography (CT), and magnetic resonance imaging (MRI), are implemented to address different lesions of cells or organs. Since each medical imaging modality has its own purposes, strengths, and limitations, one modality cannot usually provide sufficient information for a whole medical diagnosis. Medical image fusion encompasses a broad range of general image fusion techniques to integrate complementary information from different modalities of medical images. It offers a great diversity of image features for medical analysis, and often leads to the robust medical diagnosis. The additional information acquired from the integrated images can be well utilized to precisely discover the position of lesion.

II. RELATED WORK

Simultaneous image fusion and denoising with adaptive sparse representation by Yu Liu, Zengfu Wang, 2015(1). In this study, a novel adaptive sparse representation (ASR) model is presented for simultaneous image fusion and denoising. However, it may result in potential visual artefacts as well as high computational cost. (2) Multi-focus image fusion with a deep convolutional neural network by Yu Liu, Xun Chen, Hu Peng, Zengfu Wang, 2016. As is well known, activity level measurement and fusion rule are two crucial factors in image fusion. For most existing fusion methods. In this study, we address this problem with a deep learning approach, aiming to learn a direct mapping between source images and focus map. (3) Multi-view Face Detection Using Deep Convolutional Neural Networks by Sachin Sudhakar Farfade, 2015. In this paper we propose Deep Dense Face Detector (DDFD), a method that does not require pose/landmark annotation and is able to detect faces in a wide range of orientations using a single model based on deep convolutional neural networks.



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III. PROPOSED SYSTEM

The proposed system stationary wavelet transform (SWT) image fusion procedures are instigated and associated in terms of image evidence. Fused outcomes attained from these fusion techniques are evaluated through distinctive evaluation metrics. A fused result accomplished from DCT variance with CV followed by DCT variance out performs DWT and SWT based image fusion methodologies. The potentiality of DCT features creates value-added evidence in the output fused image trailed by fused results proficient from DWT and SWT based image fusion methods. The discrete cosine transforms (DCT) stranded methods of image fusion are auxiliary accurate de concert learning in real time solicitations by energy forte of DCT originated ideologies of stationary images.; they are the same size as the original image. The approximation images from the undecimated algorithm are therefore represented as levels in a parallelepiped, with the spatial resolution becoming coarser at each higher level and the size remaining the same. Stationary Wavelet Transform (SWT) is similar to Discrete Wavelet Transform (DWT) but the only process of down-sampling is suppressed that means the SWT is translation-invariant. The 2-D SWT decomposition scheme is illustrated.

IV. METHODOLOGY & IMPLEMENTATION

(1) We designed a CNN based learning scheme to measure the activity measurement and to generate the weight map automatically according to the saliency property of each pixel in the source image pairs.(2) The source image pairs were decomposed into low and high-frequency decomposed into low and high-frequency sub-bands by using a 3-level wavelet transform, and the fused image was obtained by reconstructing wavelet images with the scaled weight maps. It produced fewer undesirable artifacts ,for good consistency with human visual perception. (3) We analyzed the experimental results systematically on both quantity and quality point of view. Quantitative assessment was carried out on twelve benchmark data, and the results were compared with those of eighteen representative prior art methods. In addition, the visual qualitative effectiveness of the proposed fusion method was evaluated by comparing pedestrian detection results after fusion by using YOLOv3 object detector on a public benchmark dataset.The CNN model used in the proposed fusion method. There are three convolutional layers and one max-pooling layer in each branch of the Siamese network. Table 1 shows specific parameter of the proposed CNN. Selecting image patch size is important. There is trade-off relationship between patch size and classification performance. A large patch size results in higher accuracy since more image features are encoded by neural network, but this increases the size of fully-connected layer significantly, which affects the efficiency. On the other hand, the training accuracy by using small patch size is not robust. By considering the above concerns and the size of the dataset image, we used 16×16 patches in this work. We concatenated the 256 feature maps obtained by each branch and fully-connected it with a 256-dimensional feature vector. Then a 2-dimensional vector is further fully connected with the first fully connected layer for Soft max operation. Lastly, the 2-dimensional vector is fed to a 2-way Soft max layer which generates a probability score of two classes.

FLOW CHART:

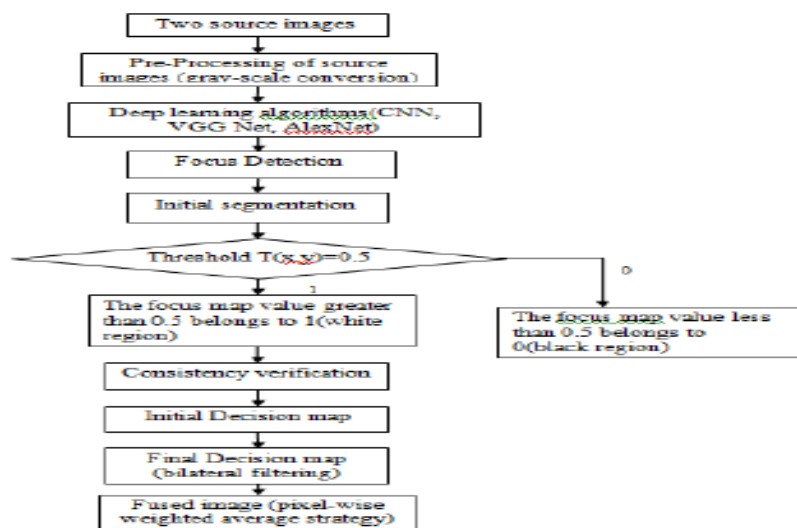


Fig.01

V. EXPERIMENTAL RESULTS

Figure 02 shows the stimulation and results an image fusion by using exemplar based Inpainting algorithm. Figure, 3 and 4(shows the input of the image as what we want given for fusion). Figure 5 shows the fusion of MRI &CT image. Which means the Fused image

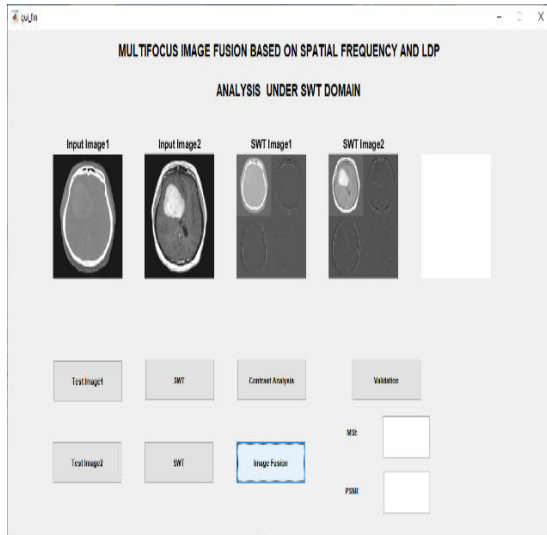


Fig.02

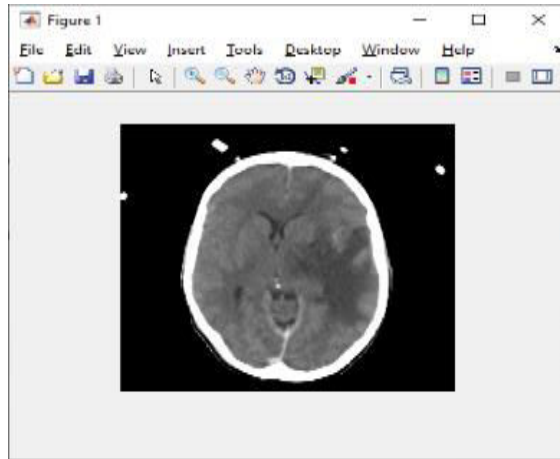


Fig.03

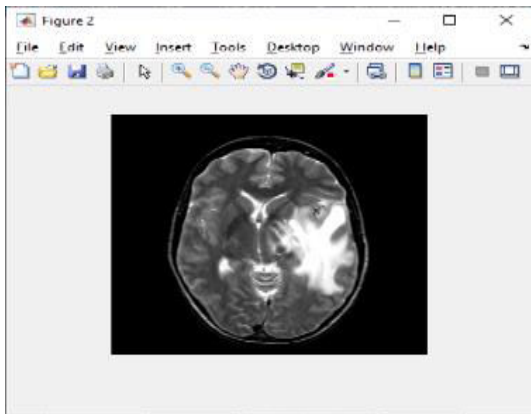


Fig.04

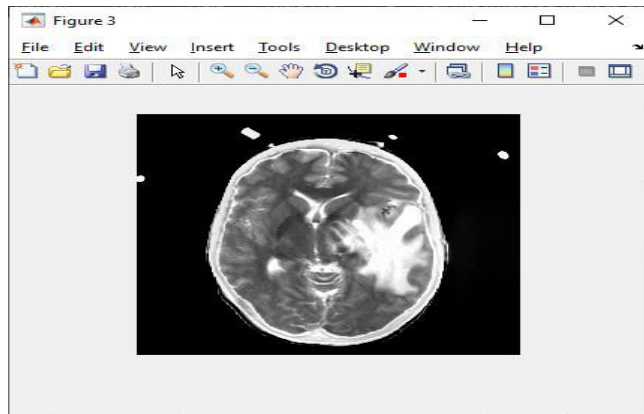


Fig.05

VI. CONCLUSION

The deep convolutional network is employed to obtain the fused image which consists of all the objects are correctly focused in a single image in terms of both foreground and background. The visual quality of the method was proved by comparing performances using an object detector on a public benchmark dataset. The quantitative assessment results show that the CNN-based fusion method was more effective than manually designed methods in terms of noise, distortion, and the intensity difference. We believe that our method is very effective and robust fusion of pre-registered multi-spectral images. As future works, we intend to develop new deep neural networks for image fusion and to improve the efficiency of fusion procedure by implementing the algorithm with parallel computing units. A bilateral filter is employed to smoothen the edge regions of the obtained decision map which produces a high quality fused image. The fused image that have focus in all the parts in a single image can be applied to different fields such as medical diagnosis to find tumours and to prospect a detailed representation of the soft tissue parts. To enhance



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performance also to process very large image dataset advanced computing techniques (dense net) and also fuzzy logic techniques may provides good results.

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