Integrate and Analyze Digital Images and Research their Development through Comprehensive, Multi-Source Information to Obtain More Accurate Information

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Abstract: **For medical image diagnosis and treatment there is use of medical image fusion which provides very good information in final fused image. There are multiple applications for medical image fusion such as surgery plan design, long distance medical treatment, clinical therapy and radiation therapy. For understanding image particular region image fusion is used which even provides more reliable information regarding target, more comprehensive and accurate method which takes multiple source images as input. Medical image fusion is nothing but multiple images for same region are combined to get clearer picture of particular region. In this paper there is study of content for image fusion, objective of this study and fusion classification for medical images. There are many difficulties found in this study for medical image fusion with problems and future scope of the medical image fusion.**

Keywords: **Image fusion, medical image fusion, multi-modality medical image, information in an image.**

1. Introduction

There is different advance equipment to obtain image of particular region for clinical diagnosis which includes different modalities such as CT scan, MRI scan, PET scan, Sonography, etc. Different organs can be scanned with multiple different scanners and resultant medical image may have different lesions information. There are two famous scan types as CT scan and MRI scan. CT medical image has advantages as very clear bone structure, lesion localization is perfect, good geometry and resolution while it has limitations of having low contrast for soft tissue. MRI medical image has advantage of clear picture of blood vessels, organs, soft tissues and other many anatomical things, lesions are properly visualized while it has limitations that it is not suitable for calcification as well as bone structure visualization is very poor. MRI scan even provides some distortions which can cause inference in geometry.

1) *Abbreviations used in paper are*
- CT: Computed Tomography
- MRI: Magnetic Resonance Imaging
- PET: Positron Emission Tomography
- SPECT: Single-Photon Emission Computerized Tomography
- MSE: Mean Square Error
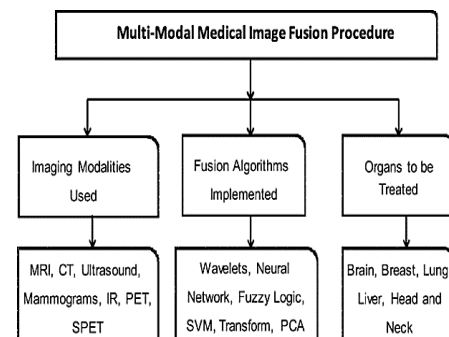- PSNR: Peak Signal to Noise Ratio

Fig. 1. Multi-modal Medical Image Fusion Procedure

There are three considerations before designing medical image fusion such as Imaging modalities used, fusion algorithm implemented and organs to be fused.
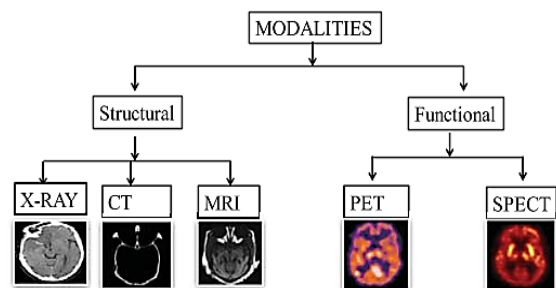

Fig. 2. Different modalities as structural and functional

X-ray, CT scan and MRI scan comes under structural modalities while PET and SPECT comes under functional modalities.

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2) Medical Image Fusion

Image fusion is very interesting method for getting detailed information which is collected from two or multiple images. Fused image will provide more information about particular organ.
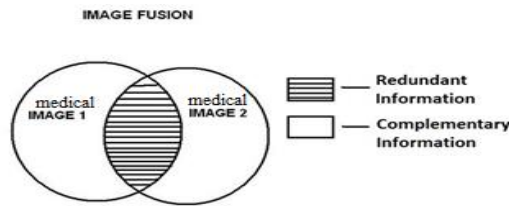

Fig. 3. Medical Image Fusion

Fusion can be done with images of different wavelength, different mechanism of capturing or use of different sensor-based images. Final fused medical image has many advantages such as better for understanding, more reliability, more accurate for multiple applications such as object detection and classification, processing, recognition, etc. [1,2]. Medical image fusion is mostly applied on image by considering that fused image must have both functional and anatomical details for given organ or tissue. Implication of medical image fusion includes help to the doctor for understanding organ or diseased tissue with more reliability and accuracy so it is easy for doctor to detect accurately and position an organ or tissue with its best treatment plan [3,4,5,6].

3) Medical Image Fusion Classification

There are different methods for image fusion. Some of them are based on

    a)   Modality: Single / Multimodality
    b)   Fusion Objects: Time / Space / Template
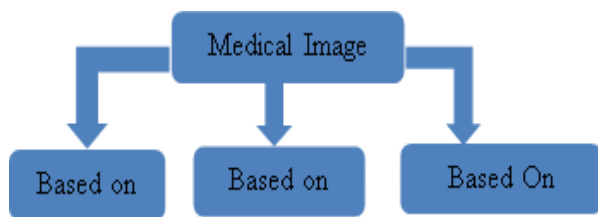   c)   Pixel/Feature / Decision

Fig. 4. Type of Medical image fusion classification types

Based on modality image fusion can be divided into single or mono mode fusion which uses only single type of modality for medical image fusion such as MR-MR medical image fusion or CT-CT medical image fusion. Multimodality or multimodal image fusion used different medical image modalities for fusion such as PET and CT image fusion, MRI and CT image fusion.

There are three types of fusion based on fusion objects such as template-based fusion, sample-time based fusion, sample-space based fusion. Template based fusion takes input as patient medical image with any modality and fuse it with template image or electronic map for diagnosis of certain disease. One sample space-based fusion uses different modalities for same organ, same time and for same patient. Obtained fused medical image can have more clear information of disease part. One sample time-based fusion uses different time slot images from same patient, same modality and same organ.

2. Medical Image Fusion Methodology and Process

Fusion of medical image can be done in some steps. It may include techniques as medical image preprocessing with the help of filters and gray scale conversion, medical image registration which tell us which disease need to detect and then fusion of medical images.
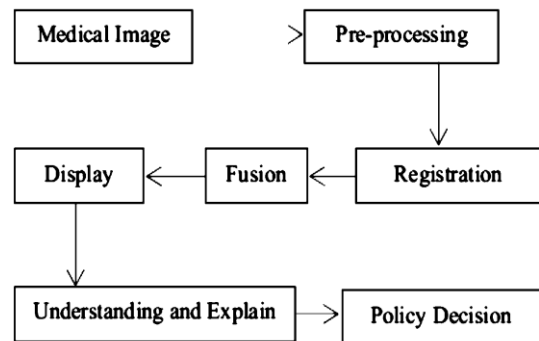

Fig. 5. Medical Image Fusion Overall Steps

Steps are as follow,

1) Preprocessing on Medical Images

Medical image preprocessing includes different techniques such as image resizing, image filtering, gray scale conversion, enhancement, etc. For designing different applications many mathematical models been used [4,5].

2) Registration of Medical Images

Spatial transformation either one or series may consider as medical image registration, corresponding points in another image can be found using same space that original image has. Anatomically located same points has same space or same spatial location. Quality of image fusion can be obtained using accurate image registration [7,8,9].

3) Medical Image Fusion

Medical image fusion should select proper rules and method for obtaining appropriate fusion which gives clear picture of required organ or disease. Basically, image fusion can be classified in three categories such as features based fusion, selection rule-based fusion and another is pixel-based fusion. Pixel based image fusion is most simple for medical images which considers weight sum of pixels from gray scale. Only for limited applications this algorithm can be used. Feature based fusion method extracts the image features to fuse image at feature level. This feature based fusion algorithm is little complex but diagnostic requirements can be obtained using this type of image fusion.

Compression technology and transform domain operations need image features from fused image for better analysis [4]. Many existing techniques such as Laplacian pyramid [10], from [11] gaussian pyramid-based image fusion and from [12] low pass ratio pyramid. Selection rule-based fusion is done using fusion rules such as fuzzy rules. Which accepts fuzzy rules from human and then operate according to rules provided.

4) *Medical Image fusion Levels*

Level based medical image fusion includes three main techniques which includes decision level medical image fusion, feature level medical medical image fusion and pixel level medical image fusion. Pixel level image fusion is very simple technique for image fusion which provides very perfect diagnosis for doctor [15]. Feature level medical image fusion mostly used for particular part from the complete image [16,17]. Decision based image fusion can be done with the help of experts and database is required but even it can work with more intelligence than other two techniques. To improve diagnostic capabilities many clinicians using such decision based and feature based techniques.

3. Limitations and Applications of Medical Image Fusion

There are many difficulties found in medical image fusion such as weak versatility which has clinical object less spreading or not visible [20,21]. Many fusion methods need different resolution, size and knowledge on different rules which provides high precision but need of expert to operate on it. Multiple images have multiple image information but which images should be mixed to get final best fused image can be detected manually. For certain criteria, which image fusion technique should be used are decided by users and not automatic. So, we need to compare ore algorithms and then need to check which algorithm is better and then decide which algorithm need to use.

1) *Applications of Medical image fusion*

  a) Image registration
  b) Exact Detection of tumor/ cancer part from scan
  c) Classification of diseases also require fused image
  d) Features selection
  e) Diagnosis of many diseases
  f) Telemedicine
  g) Computer-aided diagnosis
  h) Surgery navigation

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