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Application Based Different Techniques for Image Fusion

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Abstract:-
In various image applications, single image is not sufficient for providing better quality of image. Therefore, image fusion comes in focus to combine information from multiple sources to achieve inferences that are not feasible from a single source of image. Image fusion in applied for optimum utilization of large volume of images from multiple source images. It extracts complete information without introducing any artifacts or inconsistencies for the purpose of visual perception and computer processing. Fused image provides increased confidence, reduced ambiguity, improved reliability and improved classification and reduce overall uncertainty and redundant information from various sources. Image fusion techniques are classified on domain base such as spatial domain, transform domain and statistical domain (optimization approach). It is also categorized as multi-view, multi-focus, multi-model and multi-temporal image fusion techniques.

***Keywords :-*Image Fusion, Multi-view IF , Multi-focus IF, Multi-temporal IF, Multi-model IF.**

Introduction :-
Image fusion is the technique of extraction of information acquired in several domains.The goal of image fusion (IF) is to integrate complementary multisensor, multitemporal and multiview information into one new image containing information the quality of which cannot be achieved from single image.Image fusion is a useful technique for merging single sensor and multi-sensor images to enhance the information. The objective of image fusion is to combine information from multiple images in order to produce an image that deliver only the useful information. Image fusion is the process that combines information from multiple images of same scene. These images may be captured from different sensors, acquired at different times, or having different spatial and spectral characteristics. [1]

There are various image fusion methods based on imaging conditions, imaging geometry, noise corruption, required accuracy and application-dependent data properties of images. So according to the data entering for fusion and according to fusion purpose, image fusion methods categories as follows-

1. **Multi-View fusion** :-
Fusion of images from the same modality and taken at the same time but from different viewpoints or places or under different conditions. Multi-view image fusion improves resolution in three-dimensional microscopy. This technique is used to supply complementary information from different views. It is effective for improving the resolution and isotropy in images of transparent specimens, and improving the uniformity of the image quality of partially opaque samples. To be fully useful, the information of the sample distributed among several volumes by multi-view imaging should be combined into a single volume. [2, 3]
In multi-view image fusion, a set of images of the same scene is taken by the same sensor but from different viewpoints or several 3D acquisitions of the same specimen taken from different viewpoints are fused to obtain an image with higher resolution. The multi-view imaging capability provides extra information with respect to a single-view approach, as those regions of the specimen that are acquired with lower quality in one view will appear sharper and brighter in a different view.[1, 3]
It can be performed by two ways – single sensor image fusion and multi-sensor image fusion technique.

a. **Single Sensor Image Fusion System** :-
In this method, the sensor captures the real world as a sequence of images. The sequence of images are then fused together to generate a new image with optimum information content.[1]

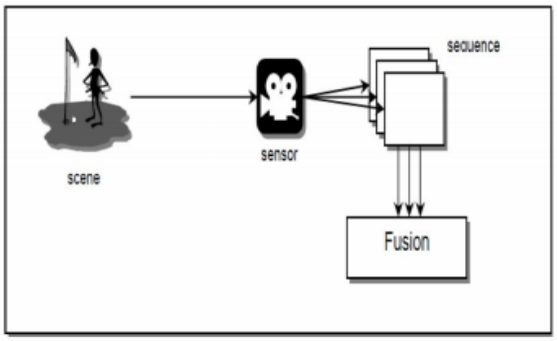

Fig 1.:- Single Sensor Image Fusion System

b. **Multi- Sensor Image Fusion System** :-

In this method, an infrared camera is accompanying the digital camera and their individual images are merged to obtain a fused image. The digital camera is suitable for daylight scenes; the infrared camera is appropriate in poorly illuminated environments.[1]

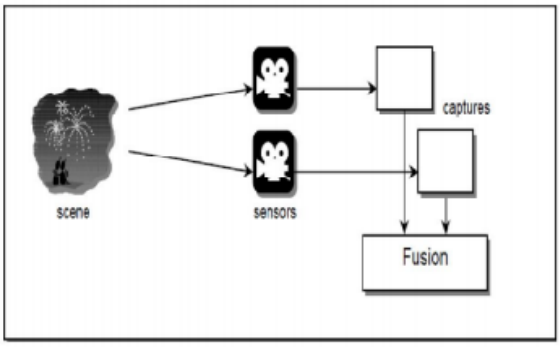

Fig. 2 – Multisensory Image Fusion System

In remote sensing and in astronomy, multisensor fusion is used to achieve high spatial and spectral resolutions by combining images from two sensors, one of which has high spatial resolution and the other one high spectral resolution. Plenty of applications which use multisensor fusion of visible and infrared images have appeared in military, security, and surveillance areas.

2. **Multi-Modal fusion** :-

Multi-model image fusion method applies on images coming from different sensors or different modalities like visible, infrared, CT, NMR, MRI, panchromatic, ultraviolet and multispectral satellite images. This method used to decrease the amount of data, to emphasize band-specific information. It uses subtraction method for implementation. [1,5]

3. **Multi-Temporal fusion** :-

In multi-temporal image fusion method, images taken at different times in order to detect changes between them or to synthesize realistic images of objects which were not photographed in a desired time. In this method, images taken at different times (seconds to years) in order to detect changes between them are fused together to obtain one single image. This technique is used for detection of changes. This method analyzes images of the same scene taken at different times in order to identify changes that may have occurred between the considered acquisition dates [1, 5, 8]

The multitemporal approach recognizes two different aims. Images of the same scene are acquired at different times either to find and evaluate changes in the scene or to obtain a less degraded image of the scene. The former aim is common in medical imaging, especially in change detection of organs and tumors, and in remote sensing for monitoring land or forest exploitation. The acquisition period is usually months or years. The latter aim requires the different measurements to be much closer to each other, typically in the scale of seconds, and possibly under different conditions. [1, 4, 5]

4. **Multi-Focus or Multi-Focal fusion** :-

With use of digital cameras, when a lens focuses on a subject at a certain distance, all subjects at that distance are not sharply focused. A possible way to solve this problem is by image fusion, in which one can acquire a series of pictures with different focus settings and fuse them to produce a single image with extended depth of field. So in this method, the original image can be divided into regions such that every region is in focus in at least one channel. Fusion of images of a 3D scene taken repeatedly with various focal lengths. In this method, image focused everywhere. It identifies the regions in focus and combines them together. [1, 3, 5]

Multifocus Image fusion is process of combining information of two or more images of a scene and as a result has "all-in-focus" image. When one scene contains objects in different distance, the camera can be focused on each object one after the other, creating set of pictures. Then, using image fusion technique, an image with better focus across all area can be generated. Multi-focus image fusion aims to combine a set of images that are captured from the same scene but with different focuses for producing another sharper image. [1,3,4]

5. **Fusion for image restoration** :-

Fusionof two or more images of same scene and modality, each of them blurred and noisy, may lead to a deblurred and denoised image. Multichannel deconvolution is a typical representative of this category. This approach can be extended to superresolution fusion, where input blurred images of low spatial resolution are fused to provide us a high-resolution image. The main idea used behind this is, each image consists of “true” part and “degradation”, which can be removed by fusion. [5, 6]

In each of the above category, fusion consists of two basic stages: image registration, which brings the input images to spatial alignment, and combining the

image functions (intensities, colors, etc) in the area of frame overlap. The images used in image fusion should already be registered. Then good information from each of the given images is fused together to form a resultant image whose quality is superior than any of input images. The quality of the merged images can be examined by comparing the classification accuracy results. Image registration works usually in four steps – Feature detection, Feature matching, Transform model estimation, Image resampling and transformation. [5,6,7]

Image registration steps are as follows -

a. Feature Detection :-

Salient and distinctive objects (corners, line intersections, edges, contours, closed boundary regions, etc.) are manually or, preferably, automatically detected. For further processing, these features can be represented by their point representatives (distinctive points, line endings, centers of gravity), called in the literature control points.

b. Feature Matching :-

In this step, the correspondence between the features detected in the sensed image and those detected in the reference image is established. Various feature descriptors and similarity measures along with spatial relationships among the features are used for that purpose.

c. Transform model estimation :-

The type and parameters of the so-called mapping functions, aligning the sensed image with the reference image, are estimated. The parameters of the mapping functions are computed by means of the established feature correspondence.

d. Image resampling and transformation :-

The sensed image is transformed by means of the mapping functions. Image values in non-integer coordinates are estimated by an appropriate interpolation technique. [5,6,7]

Conclusion :

This paper presents a review on the different image fusion techniques which is based on the data entering for fusion process and according to the fusion purpose. According to this, image fusion technique categorized as – multi-view, multi-focus, multi-model and multi-temporal image fusion techniques. This different technique improves image quality and increase the application of these data in various fields.

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