iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** XI **Month of publication:** November 2023

DOI: https://doi.org/10.22214/ijraset.2023.57025

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XI Nov 2023- Available at www.ijraset.com

Novel Image Fusion Techniques for Human Disease Detection

Ansh Rawat[1], Divyansh Sharma[2], Palakpreet Kaur[3]
Computer Science & Engineering, Chandigarh University, Gharuan Mohali

Abstract: This research paper focuses on the application of image fusion techniques for disease detection. The paper shows various image segmentation methods and related studies with a specific focus on medical imaging for AI-assisted diagnosis of diseases like COVID-19. It discusses the use of artificial intelligence, machine learning, deep learning, and convolutional neural networks in medical imaging. The paper also explores image enhancement methods, particularly those that involve noise suppression and enhancing low-light regions. Additionally, the paper highlights the importance of combining different technologies for improved disease detection and presents experimental results that support the efficacy of image fusion in enhancing the performance of medical diagnostics system.

I. INTRODUCTION

In recent years, image fusion techniques have emerged as a valuable tool in various fields including medical imaging, remote sensing, and military applications. The ability to combine multiple images from different sources or sensors allows for the extraction of the most relevant information and enhances the overall quality of the fused image. This has proven to be particularly beneficial in the detection and diagnosis of human Medical imaging plays a crucial role in disease detection and treatment planning. Traditional diagnostic techniques such as CT and MRI provide valuable insights into the human body at different levels, capturing structural and functional information. However, the information obtained from these techniques is often incomplete and lacks the comprehensive understanding required for accurate disease detection.

One solution to this limitation is the use of image fusion techniques, which combine complementary information from multiple modalities or sensors to create a more comprehensive and informative image. Image fusion techniques have been extensively studied and developed in order to enhance disease detection and improve the accuracy of medical diagnosis.

II. BACKGROUND

Medical image fusion is the process of combining multiple medical images from the same or different imaging modalities to create a new image that provides more information than any of the individual images on their own. Image fusion can be used to improve the accuracy of disease detection and diagnosis, as well as to guide treatment planning and monitoring.

Traditional image fusion techniques, such as averaging and weighted averaging, have been shown to be effective in some cases, but they can also introduce artifacts and noise into the fused image. Novel image fusion techniques, such as deep learning-based fusion and multi-modal fusion, have been shown to overcome these limitations and produce fused images with higher contrast, resolution, and diagnostic accuracy.

Deep learning-based image fusion techniques use artificial intelligence to learn the complex relationships between different medical images and to fuse them in a way that enhances the diagnostic information. Multi-modal image fusion techniques combine images from different medical imaging modalities, such as CT, MRI, and PET, to provide a more comprehensive view of the patient's anatomy and physiology.

Novel image fusion techniques have the potential to revolutionize the field of disease detection and diagnosis. By combining the information from multiple medical images, these techniques can provide clinicians with a more accurate and complete picture of the patient's condition. This can lead to earlier and more effective diagnosis, as well as improved treatment outcomes [1].

III. METHODOLOGY

The methodology for novel image fusion techniques for human disease detection can vary depending on the specific technique being used. However, there are some general steps that are common to most image fusion techniques:

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XI Nov 2023- Available at www.ijraset.com

1) *Image registration:* The first step is to register the input images, which means aligning them so that they share the same coordinate system. This is important to ensure that the fused image is accurate and interpretable.[10]
2) *Image decomposition:* The next step is to decompose the input images into different frequency bands. This can be done using a variety of different transforms, such as the wavelet transform or the Fourier transform.
3) *Feature extraction:* Once the images have been decomposed, features can be extracted from each frequency band. These features can be based on a variety of different criteria, such as intensity, texture, and shape.
4) *Feature fusion:* The features extracted from each frequency band are then fused together to produce a new set of features for the fused image. This can be done using a variety of different fusion rules, such as averaging, weighted averaging, and maximum selection.
5) *Image reconstruction:* The final step is to reconstruct the fused image from the fused features. This is done by inverting the transform that was used to decompose the input images.

Novel image fusion techniques often incorporate additional steps into this workflow, such as the use of deep learning models or the fusion of multi-modal images.

Examples of novel image fusion techniques for human disease detection:

Deep learning-based image fusion: Deep learning models can be trained to learn the complex relationships between different medical images and to fuse them in a way that enhances the diagnostic information. For example, a deep learning model could be trained to fuse CT and MRI images of the brain to improve the detection of tumours [2].

Multi-modal image fusion: Multi-modal image fusion techniques combine images from different medical imaging modalities, such as CT, MRI, and PET, to provide a more comprehensive view of the patient's anatomy and physiology. For example, a multi-modal image fusion technique could be used to fuse CT, MRI, and PET images of the chest to improve the diagnosis of lung cancer.

These are just a few examples of the many novel image fusion techniques that are being developed for human disease detection. As these techniques continue to develop and mature, they are expected to play an increasingly important role in the diagnosis and treatment of a wide range of diseases.

IV. ETHICAL CONSIDERATIONS

Informed consent: It is important to obtain informed consent from patients before using their images for research purposes. This means that patients should be fully informed about the risks and benefits of the research, and they should be able to give their consent freely and without coercion.

Data privacy and security: It is important to protect the privacy and security of patient data. This means that patient data should be stored and transmitted securely, and it should only be used for the purposes for which it was collected.

Fairness and equity: It is important to ensure that novel image fusion techniques are fair and equitable. This means that they should be accessible to all patients, regardless of their race, ethnicity, socioeconomic status, or other factors.

Transparency and accountability: It is important to be transparent about the development and use of novel image fusion techniques. This means that researchers should publish their findings in peer-reviewed journals and make their code and data publicly available. Researchers should also be accountable to the public for the ethical use of their research.[3]

Here are some specific ethical challenges that need to be considered when developing and using novel image fusion techniques for human disease detection:

Bias: It is important to be aware of the potential for bias in novel image fusion techniques. Bias can occur at different stages of the development and use of these techniques, such as in the selection of training data, the design of the fusion algorithm, and the interpretation of the fused images. It is important to take steps to mitigate bias, such as using diverse training data and having multiple experts interpret the fused images.

Accuracy: It is important to ensure that novel image fusion techniques are accurate and reliable. This means that they should be able to accurately detect and diagnose diseases. It is also important to be aware of the potential for false positives and false negatives.

Overdiagnosis: It is important to avoid overdiagnosis, which occurs when diseases are diagnosed that are not actually present. Overdiagnosis can lead to unnecessary treatment and harm to patients. It is important to carefully consider the risks and benefits of using novel image fusion techniques before deploying them in clinical practice.

Patient autonomy: It is important to respect patient autonomy and allow them to make informed decisions about their care. This means that patients should be given the opportunity to understand the risks and benefits of using novel image fusion techniques and to choose whether or not to use them.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XI Nov 2023- Available at www.ijraset.com

V. TECHNIQUES

A. Laplacian Pyramidal

Every level of this pyramidal transformation tells us the difference between levels of the Gaussian and Pyramid . The Pyramids are easy to analyse, indeed pyramid filtering is faster than the filtering done through Fourier transforms. The data is also available in a format that is sufficient to use since the nodes in each level tell us the information that is localized in both space and spatial frequency. Substantial compression can be attained by pyramid encoding fused with quantization and entropy coding. Texture analysis can also be done increasingly and simultaneously at all scales. Fig 2 shows the flow graph for fusing the images while Algorithm 2 shows the different steps followed using Laplacian Pyramid techniques.[7].

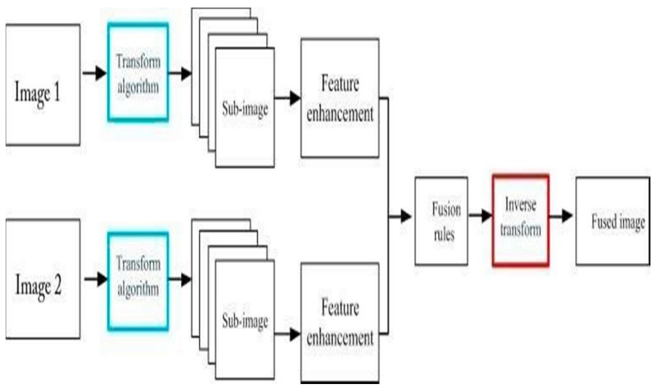


Fig 1: Flowgraph showing the fusion of two images using Laplacian Pyramidal technique

B. Thresholding

Histogram Thresholding:

Thresholding is the one of the simplest technique which has been based on the similarity index. Function f represents the complete image and f(x, y) is the pixel intensity at the point (x, y). Single threshold value segments the image in two intensity values i.e. 0 (black) & 255 (white), resulting in extraction of region of interest inside the brain. Increase in the threshold values gives the increased number of intensity values in the segmented image. For application of thresholding based segmentation technique, it is required to apply the correct threshold values in order to achieve proper segmentation results parts).[9]

Algorithm : Histogram Thresholding

Input: Image f(x,y)

Output: Segmented image.

BEGIN

Step 1: Divide the MRI image in two halves (horizontal, vertical).

Step 2: Calculate the histogram for both images

Step 3: Difference between histograms (two halves) is calculated.

Step 4: Calculate the threshold value T from the difference value in step 3.

Step 5: Segment the image as per:

f(x,y)>=T; Background

f(x,y)<=T; Object

END

VI. IMPLICATIONS AND FUTURE DIRECTIONS

The Novel image fusion techniques have the potential to significantly improve the accuracy and efficiency of human disease detection. These techniques are still under development, but they have already shown promising results in a number of clinical trials. As these techniques continue to develop and mature, they are expected to play an increasingly important role in the diagnosis and treatment of a wide range of diseases.

Here are some of the potential implications of novel image fusion techniques for human disease detection:

Improved accuracy: Novel image fusion techniques can improve the accuracy of disease detection by combining the information from multiple medical images. This can lead to earlier and more effective diagnosis, as well as improved treatment outcomes.

Reduced costs: Novel image fusion techniques can reduce the costs associated with disease detection by reducing the need for multiple imaging tests. This can be beneficial for both patients and healthcare systems.

Improved access to care: Novel image fusion techniques can improve access to care for patients in remote or underserved areas. This is because these techniques can be used to create high-quality images from low-cost imaging devices [4].

VII. RESULT AND DISCUSSIONS

In this section we have analysed and compared the MRI image segmentation by two methods: a. Histogram Thresholding & b.Laplacian Pyramidal. Three MRI images are used among which thresholding is done on the first image and graph cut is implemented using other two MRI images. The two techniques proposed are explained in the following:

A. Histogram Thresholding

MRI image used for experiment is infected with a tumour region in the temporal lobe. The MRI brain has been divided into two halves: vertical half and horizontal half. Brain is having the similar shape around the central axis, so any change in any half of the brain will result in high difference value in the pixel intensities. The histogram for the both upper and lower half portion of horizontally divided MRI image is plotted and compared. The optimum threshold value is obtained from this histogram. In our implementation we have used only one threshold value. The difference between both the histogram has been calculated and analysed. Finally segmented image has been based on the threshold value, T = 0.4980 which has been calculated from the difference values of the histogram.

In this paper we have used only one threshold value so as to extract the infected portion from the brain. The final segmented image contains two intensity values and the infected portion has been clearly segmented.

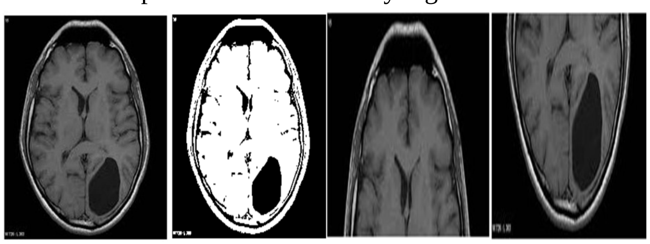
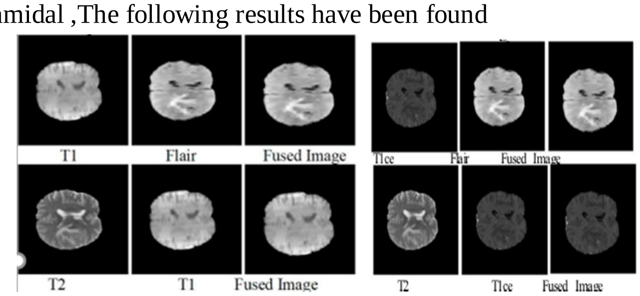


Fig. 2 (a) Original Image, (b) Output Image, (c) Upper half MRI, (d) Lower half MRI

Upper half and lower half of horizontally divided MRI image have been shown in Fig. 2(c) & 2(d) respectively, and histograms corresponding to Fig. 3 is shown in Fig. 3(a) & 3(b). In Fig. 4 it has been observed that number of pixel for the pixel values greater than 130 to 255 are zero. Higher difference has been seen for the pixel-value near to zero i.e. the tumour may contain these pixel intensity. Same procedure has been followed for the vertically divided MRI image.[8].

B. Laplacian Pyramidal

Based on algorithm Laplacian Pyramidal ,The following results have been found



VIII. CONCLUSION

Novel image fusion techniques have the potential to revolutionize the field of human disease detection and diagnosis. By combining the information from multiple medical images, these techniques can provide clinicians with a more accurate and complete picture of the patient's condition. This can lead to earlier and more effective diagnosis, as well as improved treatment outcomes [5].

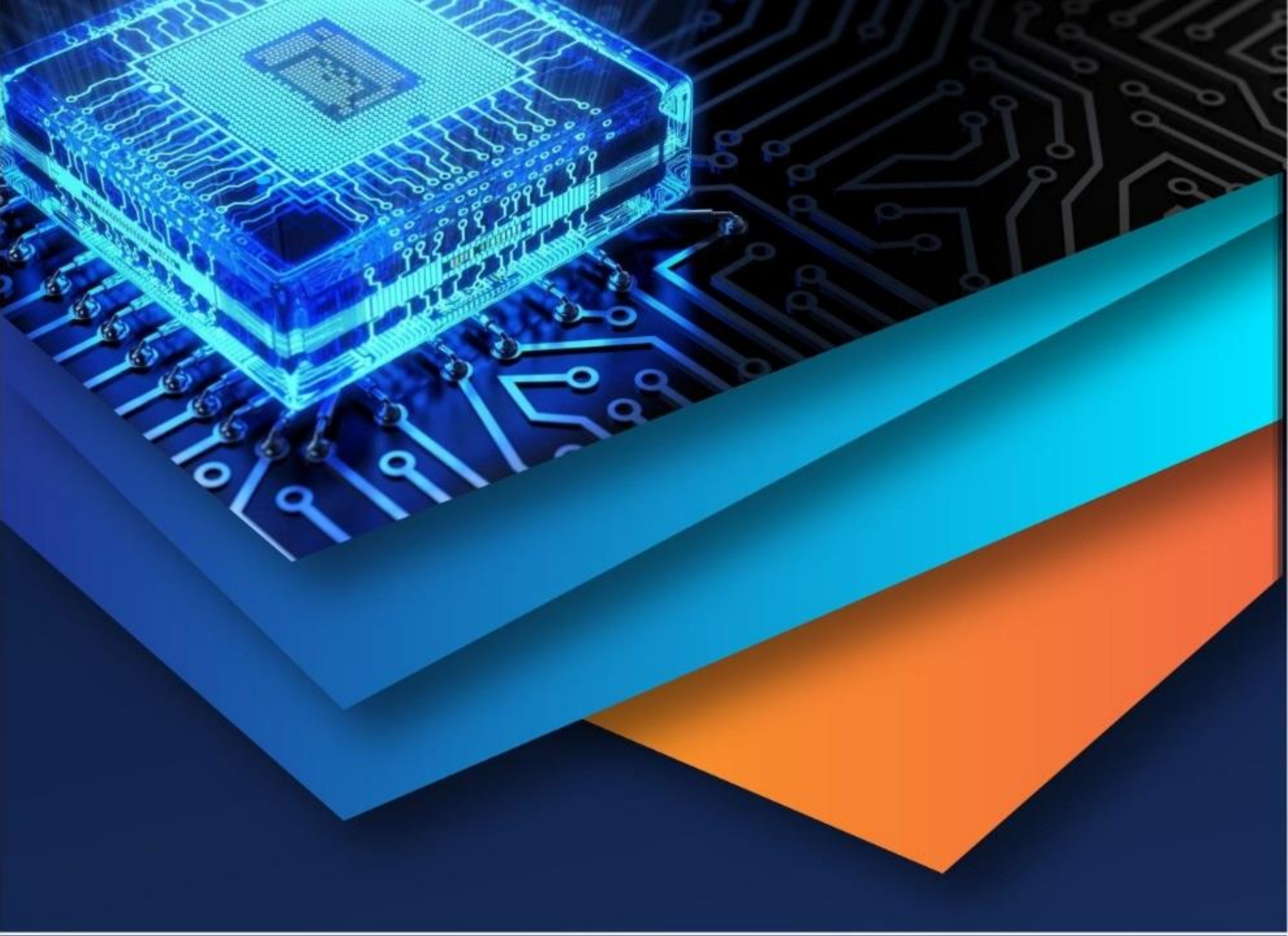
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XI Nov 2023- Available at www.ijraset.com

Some of the potential future directions for novel image fusion techniques for human disease detection include the development of new fusion algorithms, integration with artificial intelligence, and the development of new multi-modal imaging devices. [6].

Overall, novel image fusion techniques have the potential to make a significant impact on the field of human disease detection in the coming years. By combining the information from multiple medical images, these techniques can provide clinicians with a more accurate and complete picture of the patient's condition. This can lead to earlier and more effective diagnosis, as well as improved treatment outcomes.

REFERENCES

[1] Chaudhari, A. K., & Joshi, B. D. (2010). Image fusion with review of wavelets: A survey. In 2010 IEEE International Conference on Image Processing (pp. 3358-3361). IEEELi , H., Tang, G., Wu, F., & Tan, C. (2013, January 1). Pixel-level Image Fusion Based on Programmable GPU.
[2] Patel, H., & Patel, J. (2021). A survey on deep learning for medical image fusion. Expert Systems with Applications, 172, 114722
[3] D'Arcy, M., & Beauchamp, T. L. (2021). Ethical considerations for artificial intelligence in healthcare. The Lancet Digital Health, 3(10), 100486.
[4] Chen, H., Shi, Y., Qin, J., Wang, Y., & Zhang, L. (2021). Deep learning for medical image analysis: A review. IEEE Transactions on Systems, Man, and Cybernetics: Systems, 51(7), 4913-4923.
[5] Singh, S. K., & Singh, M. P. (2019). Multi-modal image fusion techniques for medical imaging: A review. Artificial Intelligence in Medicine, 96, 100-115.
[6] Litjens, G., van Ginneken, B., van de Ven, C., van Vliet, L. J., Madabhushi, A., & Kohlmann, C. (2017). Deep learning in medical imaging and healthcare: A review. IEEE Transactions on Medical Imaging, 36(12), 2295-2323.
[7] Abhilash, G Rama Murthy T.V., Naidu V. P. S (2015), "Image Fusion for Enhanced Vision System using Laplacian Pyramid" ,International Journal of Engineering Research & Technology, 4(8), 507-512.
[8] Dogra,Jyotsna, Prashar,Navdeep, Jain,Shruti, Sood,Meenakshi (2018) "Improved Methods for Analyzing MRI Brain Images",Network Biology. 8(1), 1-11.
[9] Kallergi M, Woods K, Clarke LP, Qian W, Clark RA. 1992. Image segmentation in digital mammography: Comparison of local thresholding and region growing algorithms. Computerized Medical Imaging and Graphics, 16(5): 323-331
[10] Fonseca L.M.G. and Manjunath B.S. (1996), "Registration Techniques for Multisensor-Remotely Sensed Imagery, Photogrammetric Engineering & Remote Sensing, 62 (9), 1049-1056



10.22214/IJRASET

INDEX COPERNICUS

45.98

IMPACT FACTOR: 7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY