iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** III **Month of publication:** March 2024

DOI: https://doi.org/10.22214/ijraset.2024.58979

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue III Mar 2024- Available at www.ijraset.com

"Comparative Analysis of Deep Learning-Based and Traditional Methods for Image Denoising and Restoration"

Surabhi Singh[1], Dr Ravindra Gupta[2]
Sarvepalli Radhakrishnan University, Bhopal [M.P]

Abstract: ***This paper presents a comprehensive comparative analysis of deep learning-based methods and traditional techniques for image denoising and restoration. The objective is to evaluate the performance, computational efficiency, and generalizability of these methods across various types and levels of noise in images. This report presents a comprehensive comparative analysis of image denoising and restoration techniques, focusing on traditional methods and deep learning-based approaches. The study evaluates the performance, computational efficiency, and generalizability of these methods across various types and levels of noise in images.***
Keywords: Technology of Digital Image Processing; Development Course and Use

I. INTRODUCTION

Image denoising and restoration are crucial tasks in computer vision with applications ranging from medical imaging to surveillance and photography. Traditional methods such as Gaussian filtering, median filtering, and wavelet-based techniques have long been employed for denoising. However, recent advancements in deep learning have led to the development of powerful models such as convolutional neural networks (CNNs) specifically designed for image restoration tasks. As computer networks have advanced, so too have digital picture manipulation techniques. The rising standard of arithmetic and the ongoing demand for these techniques from a range of societal industries each made a contribution to the advancement of image digital technology and opened up new avenues for its application. The first applications of digital image processing technologies were made by humans in the 1920s. They sent pictures back and forth between the US and the UK via cables. Nevertheless, the photos that were delivered were of poor quality. Image quality need to be enhanced and optimised as a result.

A. Overview of Image Denoising and Restoration

1) Importance of the task in computer vision applications
2) Introduction to traditional methods and recent advancements in deep learning-based approaches

II. SYNOPSIS OF DIGITAL IMAGE PROCESSING TECHNOLOGIES

The procedure that involves utilising a computer to convert a visual signal into a digital signal to process it The term "digital image processing", sometimes called processing images on a computer. Feature extraction, encoding, compression, segmentation, restoration, noise reduction, and image enhancement are all included in this procedure. Fig. 1 illustrates the technique for processing digital images. Without the advancement of computers, mathematics, and many sectors' growing application requirements, image processing technology cannot be produced. When technique for image processing started to be used more scientifically in the 1960s, people started using it to process output images in an idealised way.

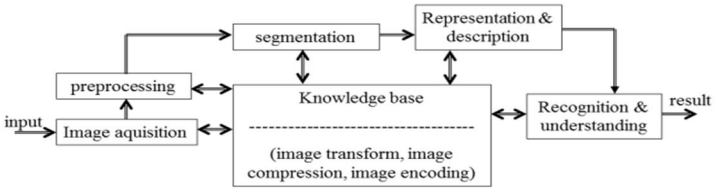


Figure 1. A schematic diagram of the process of digital image processing

From astronomical telescopes to microscopes, digital pictures can be processed. High adaptability: Almost any image can be utilised as long as it can be described mathematically and logically.

III. DIGITAL IMAGE PROCESSING FEATURES

Binary format is used by digital image processing technologies to store and record image data, making it reproducible. The process of reproducing an image won't affect the original in any way if the original information is correct, therefore it may ensure accurate information.

1) *Flexible Processing:* Digital images are distinct from traditional analogue images in that they may be utilised for any operation, including linearity. Traditional analogue images are restricted by the optical principles they produce, so they cannot be processed in accordance with people's wants and can only be handled linearly. Processing is made easier and much more flexible by operations and non-linear operations.
2) *Huge Compression Space:* The brother-in-law's photo's pixel points are not mutually oriented, but they do have some sort of link because digital photographs capture and store information in the form of pixels. A specific method of recording can be employed as long as this link is found, saving storage space by eliminating the need to record every pixel. With over 90% of the data being identical, the contents of the preceding and subsequent frames are frequently not all that different, especially when it comes to graphics, and the ratio of compression might be rather high.

IV. THE INFORMATION CONTAINED IN DIGITAL IMAGE MANIPULATION SYSTEMS

A. Getting Pictures

Prior Prior to doing any image processing, we need to get the image from the imaging point of view, or image acquisition. There is an infrared camera that particularly records infrared light, and a generic TV camera with the ability to gather overall visible light image signals from the imaging sensor's point of view. In the military, the image has a significant practical value; x-ray imaging uses objects to allow x-rays to pass through, while acoustic wave imaging uses the effect of material acoustic characteristics on the propagation of acoustic waves to acquire data and pictures of the opaque object's internal structure.

Get details on the object's internal shape from people of different genders.; possess η-ray imaging, utilise the imaging of isotope-containing γ-particles learn about the operation of human organs, identify regular or irregular human organ function Volume 163 588 of Research Developments in Intelligent Systems, and employ Using nuclear magnetic resonance imaging benefit from the variations in curves of various substances NMR: Learn about alterations in human organs and more.

B. Image Enhancement and Recovery

The obtained images are frequently distorted and disturbed in different ways. For instance, the imaging instrument has flaws. For instance, image processing must be used to produce the high-quality images needed for people to process their observations if a bandwidth restriction results in image blur, as well as the unavoidable thermal noise generated by other interference sources and during the imaging procedure. Both image restoration and enhancement fall under this category. The image is improved by using improved contour edges for colour and grayscale conversions, which better satisfies people's needs for processing and observation.

The intricate idea behind the image is to minimise or completely eradicate the harm and deterioration that are brought about by the process of acquiring and transmitting an image. This includes noise, image blur, and image interference, and it makes every effort to retain the original image. Inverse filtering is frequently a challenging and intricate procedure for image restoration.

C. Image Compression

The compression of picture data is a critical problem in image processing. The biggest challenge encountered while moving the massive amount of data of the photographs either to the user terminal saving the images for later use, especially after capturing a high quantity of both still and moving pictures, is this. An photograph with frames and colour, for instance, contains about 768 KB of data. It is challenging to store a lot of image data if no image compression processing is done. Simultaneously, this issue arises during the picture transmission process when transferring huge amounts of image data slowly or when the transmission requirements for There is excellent visual quality.(e.g., 100Mb digital TV transmission rate). In multimedia technology, image storage and transportation, and that will be discussed later, the compression of image information is a critical problem. There is a lengthy history of research on image compression coding. New techniques and technologies are still being investigated as of right now.

V. APPLICATION OF DIGITAL IMAGE PROCESSING TECHNOLOGY

With regard to multimedia technologies, picture storage and transportation that will be discussed later, the compression of image information is a critical problem. There is a lengthy history of research on image compression coding. New techniques and technologies are still being investigated as of right now.

The image quality is low due to the extremely bad imaging conditions, necessitating the use of digital image processing techniques like multi-band scanning. Imaging with a 30 m resolution; these images are processed and changed to digital signals. Digital image processing technology is widely used for a variety of purposes in numerous countries, including resource exploitation, urban planning, disaster monitoring, and forest surveys.

Table 1 Application analysis table of digital image processing

Field	Application
Physics and Chemistry	Spectrum Analysis
Biology and Medicine	Cell analysis; CT; X-ray analysis
Environment Protection	Research of atmosphere
Agriculture	Estimation of plants
Irrigation works	Lake, river and dam
Weather	Cloud and weather report
Communication	Fax; TV; phone
Traffic	Robot; products
Economics	IC-card
Military	Missile guidance; training

JPL can be used to process the pictures that the Moon and Mars have returned more effectively in the aviation industry when digital image processing technology is applied. It is primarily employed by reconnaissance planes to focus on a certain area of the planet in satellite and aircraft remote sensing technology. In aerial photography, After the digital code is generated, it can be stored in the air, necessary photographs are processed by the camera. Later, when the satellite crosses over the receiving station's area, it can pass through the processing centre. Several digital image processing techniques can be used to process judgement reading while the image is being evaluated in real time. The medical industry was the first to use digital image processing technologies. Therefore, technique for digital image processing has also been very important in the field of biomedical engineering. Techniques for processing ultrasound images, analysing ECG data, and improving X-ray images have all played a significant role in medical diagnosis and treatment.. Apart from the CT scanner previously described, there exist several technologies for processing microscopic images, mainly for the identification of red and white blood cells as well as chromosome analysis. Medical image processing, namely digital image processing, is utilised in image processing technologies including X-ray angiography and medical ultrasound imaging. The use of digital image processing technologies is crucial for improving disease diagnosis. In the real world of medicine, digital image processing is used. The non-destructive test is conducted using image overlay technology; the application of From image processing to intelligent material analysis, technology has aided in the investigation of the material's microscopic properties by humans. The stress analysis of elastic-mechanical components and the quality of parts in automated equipment wiring photos, automatic postal letter sorting, etc., are the key applications in industrial and technical fields, along with applications in intelligent robots. Digital image processing technology is mostly used in the military and public security fields for transmission and presentation of images, investigative photos, and precise missile guidance. It is mostly utilised in the fields of public security, biometric identification, and image restoration for the identification of human faces. Apart from the aforementioned application domains, Additionally, advances in digital image processing technology found widespread usage in television picture editing, clothing and hairdo design, and cultural object preservation. Digital image processing technology has been actively involved in both public security and the military. It can also be used in these domains. It is most frequently utilised in the use of automated command systems and is primarily applied to the transmission, storing, and presentation of images in military affairs. The public security professionals use an application to evaluate and decipher the images that are returned, and it has shown to be beneficial. Face recognition and image correction are the most crucial aspects of the public safety system.

VI. LITERATURE REVIEW

This section provides an overview of the state-of-the-art techniques in image denoising and restoration, including both traditional and deep learning-based approaches. It discusses the strengths and limitations of each method and highlights recent advancements and trends in the field.

VII. METHODOLOGY

The methodology involves the implementation and evaluation of selected traditional and deep learning-based image denoising and restoration methods. Traditional techniques may include Gaussian filtering, median filtering, bilateral filtering, and wavelet-based methods. Deep learning-based methods may include autoencoders, convolutional trained generative adversarial networks (GANs) and neural networks (CNNs) specifically for image denoising and restoration tasks.

VIII. EXPERIMENTAL SETUP

Experiments are conducted using standard benchmark datasets such as BSDS500, Set12, or Kodak PhotoCD to evaluate the performance of each method. Objective metrics such as peak signal-to-noise ratio (PSNR), structural similarity index (SSIM), and mean squared error (MSE) are used to quantify the quality of denoised/restored images. Computational efficiency is also measured in terms of processing time and memory requirements.

IX. RESULTS AND DISCUSSION

The results of the experiments are presented and analyzed to compare the performance of traditional and deep learning-based methods in terms of denoising effectiveness, restoration quality, and computational efficiency. The strengths and weaknesses of each approach are discussed, along with insights into their applicability to different types and levels of noise in images.

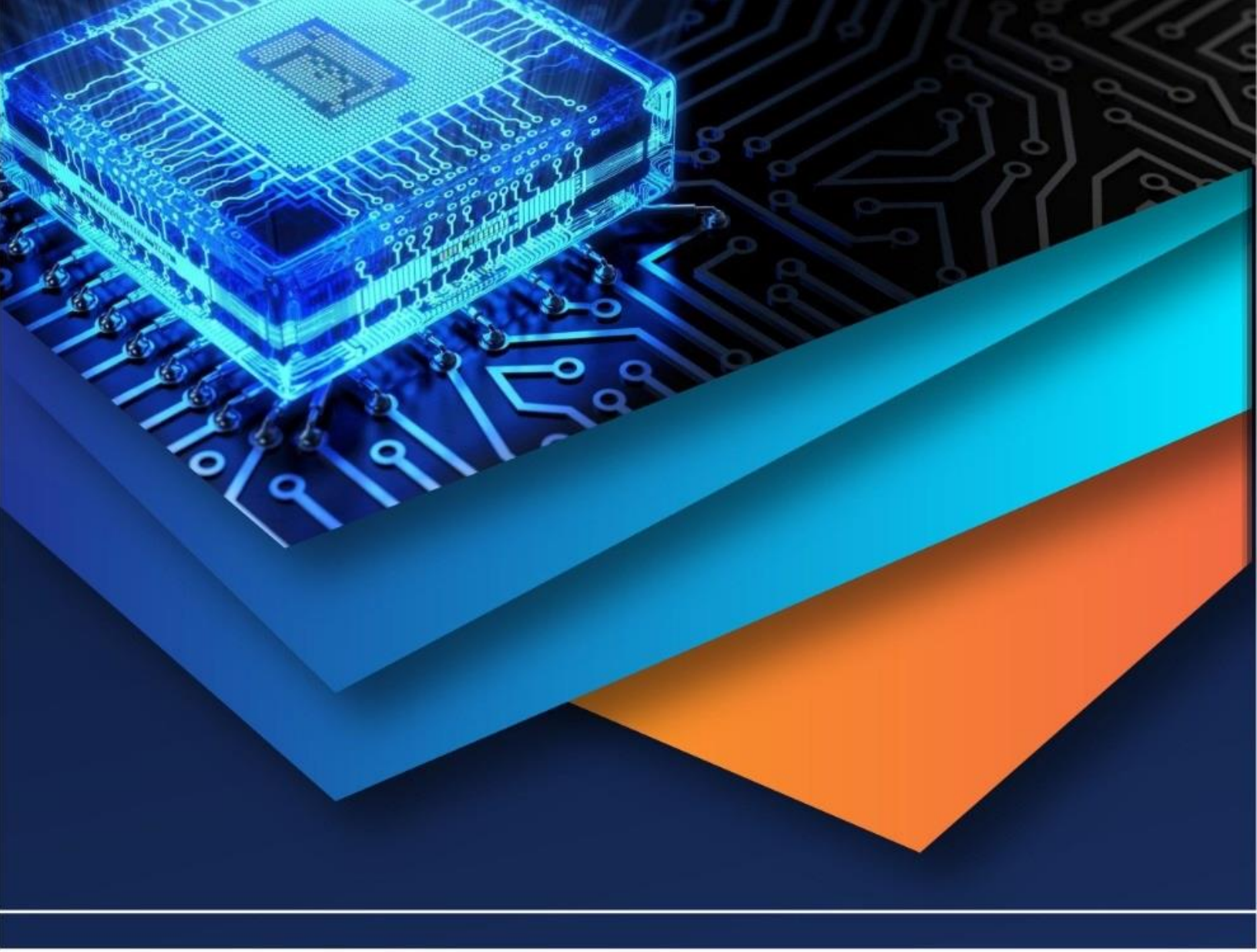
1) Presentation and analysis of experimental results for each method
2) Comparison of traditional and deep learning-based approaches in terms of denoising effectiveness, restoration quality, and computational efficiency
3) Insights into the applicability of each approach to different types and levels of noise in images

X. CONCLUSION

The paper concludes with a summary of the findings and identifies areas for future research. It highlights the potential of deep learning-based methods for image denoising and restoration while acknowledging the continued relevance of traditional techniques in certain scenarios. In conclusion, this study examines the development trend of digital image technology after first analysing the research state and key application domains Technology technologies for digital image processing. Technology for digital image processing is currently used in many aspects of daily life. For instance, the growth of technique for digital image processing is tightly tied to people's lives through its apps for mobile devices, networks, etc. Technology for digital image processing will continue to be acquired as long as it is developed continuously. Advancements also require additional individuals to conduct research.

REFERENCES

[1] Kong Dali, Cui Yang. Research Status and Development Direction of Digital Image Processing Technology. Shandong Institute of Water Conservancy, 2012(04):11-14.
[2] CHEN Bingquan, LIU Hongli, MENG Fanbin. Current Status and Development Direction of Digital Image Processing Technology. Journal of Jishou University(Natural Science Edition), 2009(01):63-70.
[3] Lu Gejing.Discussion on the status quo and development of digital image processing technology.Computer Knowledge and Technology,2012(33):8035-8036.
[4] Ding Ke. Research and Development Direction of Digital Image Processing Technology. Economic Research Guide, 2013(18): 246-270.
[5] Rafael C. Gonzalez, Richard E. Woods and Qiuqi Ruan(Translator): Digital Image Processing (Third Edition) ,Electronic Industry Press,China,2017
[6] Elham Yousef Kalafi, Wooi Boon Tan and Christopher Town, etc. Automated identification of Monogeneans using digital image processing and K-nearest neighbour approaches. BMC Bioinformatics, 2016, Vol.17 (19)



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY