A Review Paper on image segmentation, enhancement, and classification

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ABSTRACT

Image processing is a relatively recent field in which much research has been conducted. Image processing is a signal processing technique that receives an image as input and produces an image or a group of characteristics or qualities connected to images. Image processing aims to improve image quality by removing undesirable features. There are approaches for image segmentation, enhancement, classification, restoration, pattern recognition, extraction, and more. We studied some image processing approaches in depth in this paper, including image segmentation, image enhancement, and image classification, as well as numerous research works on image processing techniques employing various deep learning algorithms.

I. INTRODUCTION

Image processing techniques have become more crucial in many applications as computer technology develops [1]. Because vision is the most important sense in humans, images have always been important in their lives. As a result, image processing has a diverse set of uses (medical, military, and so on)[2].

An image can be represented as a matrix, with each element carrying color information for a single pixel. Images can be divided into four categories: black and white or binary, grayscale, color, and multispectral. As in digital circuits, black and white images have two logic levels: 0 or 1 [3]. Because black and white only have two colors for shading, adding more shades is referred to as Gray shading. Red, green, and blue are commonly used to represent color images (RGB images). The other sort of image is a multispectral image, which is not an image in the traditional sense because it contains information outside the normal range of human perception. Infrared, ultraviolet, X-ray, auditory, and radar data are examples. The image is regarded as one of the most effective methods of data transmission.

The process of turning a physical image into a digital representation and removing the most crucial details is known as image processing. Image processing techniques are important in image acquisition, pre-processing, clustering, segmentation, and classification procedures for a variety of images, including fruits, medical images, vehicles, and digital text images, among others [4] [5]. Picture processing techniques are crucial in image capture, image pre-processing, clustering, segmentation, and classification procedures for a variety of images, including fruits, medical, automotive, and digital text images [6].

The development of deep learning in the last ten years has been among the most crucial developments in artificial intelligence. Image processing has been quite successful with it [7]. Although the subject of digital image processing is extensive and frequently calls for difficult mathematical techniques, the underlying idea is rather simple [8].

Deep learning (DL) approaches are gaining popularity for a variety of image processing jobs. Convolutional neural networks and recurrent neural networks are two frequently used techniques for obtaining cutting-edge results on satellite and aerial data in a variety of applications [7].

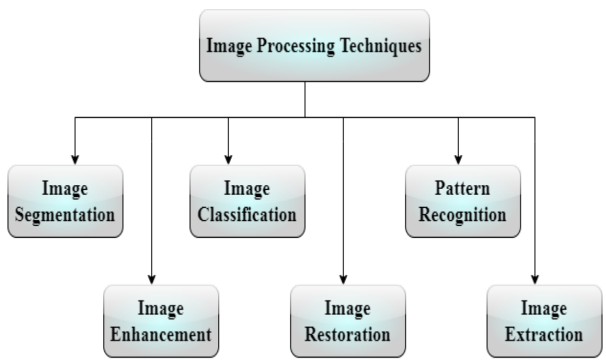

Figure 1. Techniques of image processing

The contribution of this Article:

As image processing is such an important and difficult task in solving real-world problems, we will look at the different types of image processing and their approaches in this study. This work provides a systematic examination of numerous image processing techniques used to develop multiple models for picture segmentation, image enhancement, and image classification to produce better images. In the tables below, we've discussed recent work in this field. This research will benefit students studying computer science, biomedical science, and other related subjects.

Summary of articles related to three techniques of image processing: Image segmentation, Image enhancement, and image classification.

Table (1) - Detailed literature review of image segmentation

Threshold-based segmentation: Picture thresholding segmentation is a simple image segmentation technique. Making a multicolor or binary image is possible by adjusting the pixel intensity of the original image's threshold value [9].

Edge detection segmentation: Identifies edges in a picture by using various edge detection operators. These edges highlight visual contrasts in texture, color, and other elements. As we move from one area to another while walking, the degree of grey could change. Identifying that discontinuity will allow us to locate that edge [10].
Region-based segmentation: This technique separates the Computed Tomography image into multiple pieces that have similar characteristics. It's possible that pixels can be compared in terms of brightness, color, and other elements.[10].
Clustering-based segmentation: It is a pixel-wise segmentation approach for Image Segmentation. The image is divided into numerous spaces with comparable features as the first stage in area splitting and merging-based segmentation, and then adjacent religions with some resemblance are combined [11]**.**
Artificial Neural Network-based segmentation: AI-based segmentation techniques are founded on the idea that the human brain can learn to make decisions. This segmentation approach is widely utilized in the segmentation of medical images because it isolates the image's useful information from the background.[10]**.**

Table (2) – Various techniques of image segmentation

Method Used	Description	Dataset used	Findings	Reference of paper
Support Vector Machine (SVM) and Convolutional Neural Network (CNN)	Segmenting low-grade gliomas in MR images of the brain.	From the cancer picture archive, MR images were retrieved.	Accuracy:- CNN: 0.998	[12]
Fully Convolutional Network(FCN)	In this study, a method for semantically segmenting images of weeds and rice seedlings in paddy fields based on fully convolutional networks was proposed.	Weeds in paddy fields were captured with a Canon IXUS 1000 HS (EF-S 36-360 mm f/3.4-5.6 IS STM) camera. (There are 28 photos).	Accuracy: 92.7%	[13]

Random Forest, Support Vector Machine, and K-Nearest Neigh-bor (RF)	This research describes a ground-breaking attempt to segment psoriasis skin biopsy images automatically.	An annotated real psoriasis skin biopsy Image dataset of 90 images.	(Cropped picture patch classify-cation perfor-mance) CNN: 95.17	[14]
BrainSeg-Net Model	Enhances semantic segmentation of MR brain tumor picture.	BraTS 2017, Brats 2018, and BraTS 2019.	BrainSeg-Net performs better than a variety of existing brain MR image segmentation methods.	[15]
Fully convolu-tional network (FCN) based on modified U-Net is referred as PsLSNet	Segmenting psoriasis lesions from RGB photos using a fully automated technique. A modified U-Net-based fully convolutional network architecture was used to develop a consistent training method and model.	5241 psoriasis lesions images collected by a dermatologist from 1026 psoriasis patients.	Accuracy: 94.80%	[16]
Novel hybrid densely connected UNet (H-DenseUNet)	Liver and Tumor Segmentation From CT Volumes Using a Hybrid Densely Connected UNet.	Liver Tumor Segmentation (LiTS) Challenge from MICCAI 2017 and 3DIRCADb.	The technique outperformed other cutting-edge tumor segmentation discoveries and produced very competitive liver segmentation performance.	[17]

Artificial Neural Network (ANN)	Based on dermoscopy pictures, this research creates a melanoma skin cancer diagnosis system. ANN classifier is used to extract features from photos of benign and malignant melanoma and classify them accordingly.	MICCAI 2017 LiTS Challenge and 3DIRCADb Dataset	Accuracy: 98%	[18]
Convolutional Neural Network (CNN)	Image Segmentation Performance Analysis of Deep Learning CNN Models for Disease Detection in Plants.	Independent data previously unseen	Accuracy: 98.6%	[19]
Non-dominated Sorting Genetic Algorithm (NSGA-II) based image clustering	A tea leaf disease detection model that uses computationally intelligent methods including NSGA-II, multi-class SVM, and PCA. The proposed approach can identify five distinct illnesses in tea leaves.	Images captured by mobile cameras from three tea gardens. The majority of the image samples are contaminated with different diseases, although others are unaffected.	Accuracy: 83%	[20]
Small Tumor-Aware Net-work, a deep learning frame-work (STAN)	The Small Tumor-Aware Network (STAN) was proposed in this research to address issues in breast tumor early detection.	(Public datasets) BUSIS dataset (562 images)and Dataset B (163 breast ultrasound images)	It performed better at segmenting small tumors on two public datasets than the other three segmentation methods.	[21]

Content-based image retrieval, DeepLab v3 is used for semantic segment-ation and ResNet-34 for classi-fication.	Fuzzy clustering is used in a content-based satellite image retrieval system.	PASCAL VOC2012 dataset.	Compared to the existing method, efficient picture retrieval.	[22]
Deep Neural Network (U-net architecture)	Using the U-net architecture, one of the most popular deep learning models for image segmentation, to segment CT images.	Different datasets	0.9502 Dice-Coefficient index	[23]

Table (3) - Detailed literature review of image enhancement

Histogram equalization (HE): The objective of HE is to distribute the grayscale in an image uniformly. The probability of each grey level emerging is therefore equal. To improve image quality, HE adjusts the brightness and contrast of dark and low-contrast images. [24].
Contrast limited adaptive histogram equalization (CLAHE): Adaptive histogram equalization (AHE) is a better variant of HE. Patches of the image are subjected to AHE, which uses histogram equalization to boost the contrast for each area individually. It does this by adjusting the local borders and contrasting in each area the picture to the local pixel distribution. When compared to HE-created images, those modified with CLAHE appear more realistic. [24].
Image invert/complement: Image inversion, also known as complement, is the technique of inverting black and white in a binary image by turning zeros into ones and ones into zeros.
Gamma correction: A non-linear procedure known as gamma correction is carried out on the pixels of the source image. By employing the projection link between the pixel value and the gamma value according to the internal map, gamma correction alters the pixel value to improve the image.
Balance Contrast Enhancement Technique (BCET): By extending or compressing the image's contrast without altering the histogram pattern, BCET is a method for enhancing balance contrast. The parabolic function was taken from the picture data to determine the solution.

Table (4) – Various techniques of image enhancement

Method Used	Description	Dataset used	Findings	Reference of paper
Image complement, gamma correc-tion, balance contrast enhancement approach, histogram equalization (HE).	The effects of image enhancement methods on COVID-19 detection were examined using five different picture enhancement techniques. 7 different deep CNN networks were employed for classification, while a modified Unet network was used for segmentation.	Chest x-rays totaling 18479 (3616 COVID).	Accuracy: 96.29%	[25]
NCACC, a novel contrast-adaptive color-correcting method	The back-propagation neural network (BPNN) with contrast-adaptive color correction technique (NCACC) is fed the gray-level co-occurrence matrix (GLCM) feature extraction as picture upgrades for underwater fish classification in the marine environment.	LifeCLEF 2014 (LCF-14) or Fish4Knowle-ge image	Accuracy: 93.73%	[26]

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The terms "Histo-gram Equali-zation," "Local Histogram Equalization," "Contrast Limited Adaptive Histogram Equalization," "Gamma Correc-tion," and "Linear Contrast Stretch" are used.	Compared the performance of five classic algorithms for post-flood satellite picture enhancement.	16 multispectral images were produced by combining images from the Landsat 8 Operational Land Imager with the Landsat 5 Thematic Mapper.	LHE (scores of the output images based on BRISQUE- the Blind/Refere nce less Image Spatial Quality Evaluator) is an accurate method.	[27]
The entropy-based intuition-mistic fuzzy technique with Contrast limited adaptive histogram equalization (CLAHE).	Entropy-based fuzzy intuitionistic and CLAHE methods are proposed to make mammography images more visually appealing.	MIAS database consists of 322 distinct 26 categories of mammo-gram images.	Without modifying the informa-tional content or structure of the image, The sugg-ested method eliminates uncertainty in the boun-dary or area of concern. It can be used to pre-process fatty glands, dense glandular mammo-graphy, and mammo-grams with	[28]

			fatty tissue.	
A novel contrast-adaptive color-correction (NCACC)	A method for improving the quality of underwater photos that are prone to strong color distortion and diverse sounds.	LifeCLEF 2014 (LCF-14), known as the Fish4Knowlege dataset	Boost the visual contrast without introducing a lot of noise	[29]
MATLAB (Image enhancement techniques)	Edge enhancement, grey-level slicing, saturation transformation, hue, intensity, and contrast can all be applied to an image utilizing image enhancement techniques.	Randomly selected images.	Histogram equalization is used then appearances best result in maximum conditions.	[30]
CNN-based SICE enhancer (Single image contrast enhance-ment).	Created a SICE enhancer using CNN technology that can adaptively produce high-quality enhancement results for a single input image that is either overexposed or underexposed.	A dataset of high-resolution photos with different exposures that contain 4,413 image sequences and 589 image sequences.	The results demonstrate that, in dynamic circumstance s, the developed SICE enhancer outperforms cutting-edge SICE approaches as well as MEF and stack-based HDR techniques.	[31]
Classical color transfer method.	Perceptual color transfer, based on image processing a technique for	200 RGB photos from a dark imagery collection were obtained using	Results from perception space color transfer are	[32]

	converting dark-time data into scenes resembling daylight, is used to improve dark images.	a common camera and the BSDS300 database.	better than those from RGB color transfer. The finest natural color transfer occurs when using PCT (perceptual color space) in the RLAB space while simulta-neously reducing noise.	
High-resolution image enhance-ment wavelet-based algorithm	For a Satellite Image's edge smoothness compute the subband images LL, LH, HL, and HH using the three-level discrete wavelet transform (DWT). The Scalar Smoothness Index (SSI) measures the image's overall edge smoothness. This is used to filter out the high-resolution image.	A total of ten photos are taken into account. Original photos, and enhanced images after using the SSI factor on each of the enhanced images.	The results show that using DWT to improve the high resolution of satellite images is not difficult.	[33]
An efficient imaging-based technique for image enhancement.	Due to the characteristics of photographs taken inside highway tunnels, an imaging model estimate is used to realize tunnel image enhancement. This research suggests a	Survei-llance footage from the Chongqing Yu Wu highway tunnel was used as experiment-tal data.	For tunnel picture restoration, the proposed approach works well. The procedure of enhancement	[34]

	quick transmission estimation method based on constraints imposed by the imaging model.		takes only a few seconds.	
Contrast Limited Adaptive Histogram Equali-zation (CLAHE)based Fusion Algori-thm.	YIQ and HSI Color Spaces Contrast Limited Adaptive Histogram Equalization for Underwater Image Enhancement. This work presents a fusion method for several color spaces to improve underwater photo contrast and color without sacrificing significant details or color cast.	Original underwater pictures. Two original underwater images were picked for the method enhance-ment.	The suggested approach can be used to improve the contrast and entropy of degraded underwater photos and other remote-sensing images.	[35]
Statistical and logarithmic image process-ing (LIP) based enhance-ment algori-thms	An RGB color improvement framework for LIP-based statistical and logarithmic image processing (LIP) enhancement methods. The suggested method is less complex than the majority of existing algo-rithms, but it improves the color results of grayscale-based contrast enhancement techniques.	Randomly chosen images.	Image complexity reduction and improved image color fidelity.	[36]

Table (5) - Detailed literature review of image classification

Artificial Neural Networks (ANN): It is a distributed parallel processor with a natural tendency to store experiential knowledge. ANN simulates brain behavior to solve problems. It consists of an input layer, one or more hidden layers, and an output layer among the different layers of neurons.
Convolutional Neural Networks (CNN): It is a type of neural network that analyze data using a grid-like structure. Both time-series data and picture data, which is a two-dimensional grid of pixels, can be utilized with this.
Recurrent Neural Network: This algorithm is perfect for machine learning problems requiring sequential data because it contains internal memory that remembers its input.
Support Vector Machine: This technique produces a set of hyperplanes in a high-dimensional space that can be applied to regression or classification. The hyperplane achieved satisfactory separation. SVM uses a non-parametric binary classifying technique to handle more input data effectively. Accuracy is impacted by hyperplane selection.
K-Nearest Neighbor (KNN): It uses a simple method to classify new cases based on similarity and store all of the existing cases.

Table (6) – Various techniques of image classification

Method Used	**Description**	**Dataset used**	**Findings**	**Refe-rence of paper**
Canonical Correlation Analysis (CCA) applied to (Convolutional Neural Networks + Recurrent Neural Networks) (CNN + RNN).	Employing canonical correlation analysis and deep learning to classify images of white blood cells.	12,442 blood cell pictures from the Shenggan/BCCD Dataset and kaggle.com/paultimothymooney/blood-cells/data.	Accuracy: 95.89%	[37]

Connvolutional Neural Networks (CNN)	In this study, the effectiveness of well-known convolutional neural networks (CNNs) for object detection in live video feeds is assessed.	Google, Alex Nets, and ResNet 50. There are numerous picture data sets available to test the effectiveness of various CNN architectures.	Compared to Alex Net, Google's and ResNet50's object recogni-tion algori-thms are more accurate.	[38]
Convo-lutional Neural Networks (CNN)	Defective Image Classification of Industrial Components Using Convolution Neural Networks and dropout techniques, the PyTorch framework can identify and recognize industrial camera component images and filter out defective components.	Images of the components were taken using a specific industrial camera.	Accuracy: 91%	[39]
Advanced CNN (Convo-lutional Neural Networks with Tensor-flow Frame-work).	The input data for this study mostly focused on Plants categories, which are identified using leaves. CNN is the preferred approach for gathering training and test data.	CIFAR 10 dataset.	Accuracy: 95%	[40]
Convo-lutional Neural Network (CNN) (improved VGG16 convo-lutional neural network model.	Improved Convolutional Neural Network Image Classification Algorithm.	Data was collected from Kaggle. (Cat and dog dataset with 25,000 training samples and 1000 test samples).	Improved accuracy:	[41]

Convolu-tional Block Attention Module (CBAM) with the Mobile NetV2, VGG16, and ResNet50 is a combined approach.	A novel approach for categorizing Asian cuisine images that complies with the objectives of the CBAM attention mechanism and Mixup data improvement.	100 different varieties of Asian food are depicted in 14361 images in the experimental dataset.	Accuracy: 87.33%	[42]
AlexNet architect-ture with convo-lutional neural networks.	Four test images from the AlexNet database were selected: a sea anemone, a barometer, a stethoscope, and a radio interferometer for testing and validating deep learning's ability to categorize images.	Four test images are selected from the ImageNet collection.	The fact that the images are accurately classified even for a subset of the test images demonstrates the efficiency of the deep learning system.	[43]
Artificial Neural Network (ANN)	A fully automatic model-based segmentation and classification method for MRI brain tumors is presented using artificial neural networks. The resulting image is developed using ANN to get the segmented tumor.	Medical MR digital pictures gathered from several databases (200 MRI images).	Recorded identification precision is 92.14%	[44]

Support Vector Machine (SVM)	In this paper, a deep learning-based algorithm is employed to identify COVID-19-infected patients using X-ray images.	From the Montgomery County X-ray Set, 10 photos of normal lungs, and 10 images from the public database COVID-chest X-ray dataset master.	Accuracy: 97.48%	[45]
Deep neural network (DNN) Deep Learning by using frame-work Tensor-Flow	DNN-based image categorization system implement-tation. Five distinct types of flowers were used in this investigation, with the input data mostly focusing on the floral category.	ImageNet Dataset.	Accuracy: 90%	[46]
Convolu-tional Neural Network (CNN)	CNN, a machine learning algorithm, is used in this technique to automatically categorize images.	MNIST dataset.	Accuracy: 98%	[47]
CNN-Convolutional Neural Network	The performance of the super-vector coding of the local image descriptors method, the SVM method, and the region ranking SVM method is compared to the deep learning algorithm for multi-class image classification, the CNN model, and the results.	PASCAL VOC 2007 dataset.	The accuracy of the CNN model is comparable to that of SVM and RRSVM approaches, and it is superior to the Super-vector coding of the local image descriptor.	[48]

An object classification deep learning system.	A high-resolution deep learning method for classifying buildings and objects in multi-spectral satellite images.	IARPA fMoW dataset of one million pictures in 63 classes	With an accuracy rating of 95%, it categorizes 15 classes.	[49]
Two novel light-weight networks that include dense connec-tivity and 1 x 1 convolu-tional layers to learn features via parallel channels.	In this study, a deep network is employed to classify traffic signs. The performance of the different methods used is compared.	Using the knowledge of the network trained on CIFAR -10, train the network on the GTSRB and BTSC traffic sign datasets.	On both datasets, accuracy was 99.61% and 99.13%, respectively.	[50]
Hybrid convolutional and Recurrent Deep Neural Network.	To categorize histological images of breast cancer, a hybrid deep neural network was employed.	ImageNet dataset.	For the 4-class classification task, the average accuracy was 91.3%.	[51]

II. SEARCH STRATEGY

We used Google and Google Scholar to search for various articles and papers. We choose recent research papers from various types of journals for image segmentation, enhancement, and classification as mentioned in the above tables for the investigation of various algorithms used for image processing techniques. We have searched the papers, and journals on “Google Scholar” by writing: research papers on image segmentation/image enhancement/image classification, research in a variety of image fields segmentation/image enhancement/image classification and various methods used, image segmentation/image enhancement/image classification techniques, image segmentation/image enhancement/image classification using various algorithms. We have searched the papers, On an average of 96. Papers were chosen from a variety of international conferences, including the International Journal of Recent Technology and Engineering (IJRTE), the International Conference on Advances in Electrical Engineering (ICAEE), PLOS ONE, Elsevier, Preproofs, WILEY, the International Conference on Computer

Engineering and Applications (ICCEA), the Journal of Theoretical and Applied Information, and many others. There are many further references utilized. After reviewing all of the papers, a total of about 65 were chosen.

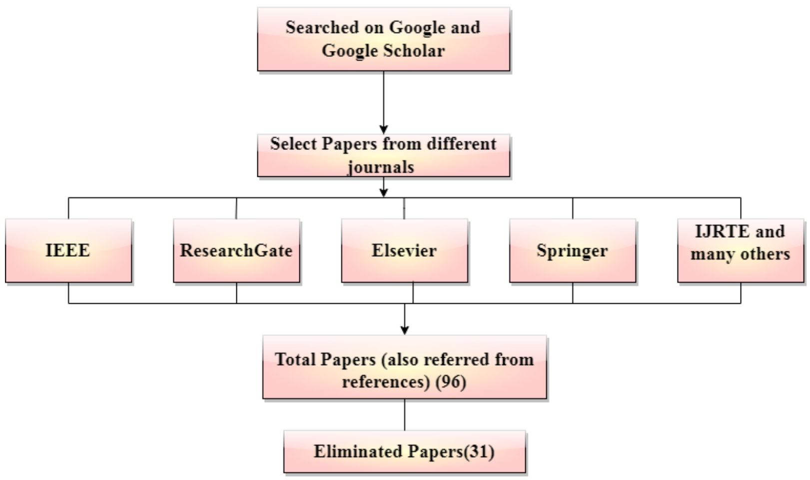

Figure 2. Diagrammatic representation of various journals used

III. COMPREHENSIVE LITERATURE STUDY FOR SOME IMAGE PROCESSING TECHNIQUES

As previously discussed, image processing. Let's look at the three image processing approaches in more detail: image segmentation, image enhancement, and picture classification.

A. *Image Segmentation*

It is one of the various image processing methods used to assess a specific image. Image segmentation is the first stage in analyzing and extracting information from photos [52].

The process of breaking down an image into its items or sections is known as segmentation. Segmentation is the division of a picture into coherent portions based on some criteria [53]. Binary images are one of the most suited formats for digital processing such as image thresholding and segmentation. An array of weights with values ranging from 0 to 255 is used for grayscale graphics. The values between 0-255 signify different shades of grey, with weight 0 denoting black and 255 denoting white. Color visuals are described using the RGB (Red, Green, and Blue) triples. The weight runs from 0 to 255, with 0 representing no primary color and 255 representing the peak value of the main color in that pixel [54].

Image segmentation is the most crucial procedure in image processing and analysis. The results of segmentation affect all future image analysis operations, such as object representation and description, feature measurement, and even more advanced tasks like object classification. [55].

In a variety of applications, such as agricultural monitoring, urban planning, and deforestation identification, satellite images are employed as referential data because of their extreme

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complexity and wide range of content representations. As explained in the reference work [56], these photographs include a considerable amount of useful data that is difficult to recognize manually. We have also discussed the various techniques of image segmentation in the above section. In [57] paper various image segmentation techniques are discussed with their advantages and disadvantages.

B. Image Enhancement

It is one of the most crucial methods, the main goal of image enhancement is to modify a given image so that the finished product is better suited for a certain application than the original image [58]. To make a visual display more useful for presentation and analysis, it emphasizes or sharpens image elements such as edges, boundaries, or contrast [59]. The enhancement techniques can be broadly classified into the following two categories as shown in Fig. (3):

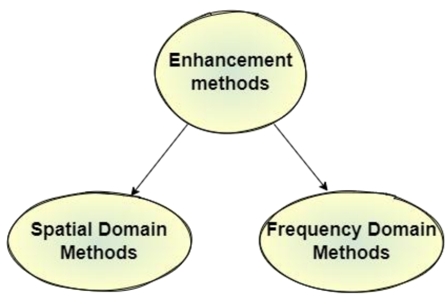

Figure 3. Methods of enhancement

In spatial domain approaches, we work directly with the image pixels. To accomplish the desired improvement, the pixel values are changed. In frequency-domain techniques, the image is first translated into the frequency domain [60].

Numerous photos, including those used in medicine, satellite, aerial, and real-world photography, suffer from inadequate contrast and noise. To improve image quality, the contrast must be improved and the noise must be eliminated. To gather valuable data about a digital image, the image enhancement method is crucial. To enhance the aesthetic effects of the provided image, a warped procedure may be used [61]. Various image enhancement techniques are useful in many domains, including bacteriology, law enforcement, microbiology, and biomedicine. [8] [60].

The image enhancement techniques for underwater images, video, and image defogging algorithms, image enhancement techniques for medical images and infrared images, and contrast enhancement techniques. Heuristic and classic image enhancement approaches are two types of recent image enhancement techniques [62].

Using the type-II fuzzy method, several writers have proposed various medical image-enhancing algorithms. For picture improvement, the presents type-II fuzzy computing approaches. In this paper, they compared the fuzzy type1 and type2 methods, and in most cases, it gives better results However, the proposed strategy does not produce improved results for document pictures [63].

This research compares the edge-detected pictures of photographs taken in clear and foggy situations to determine a hazard. The results of the SUSAN edge detection algorithm are also compared to state-of-the-art edge detection algorithms in the publication [64].

The tone curve and contrast of an input image are changed using single-picture contrast enhancement techniques. For training a single image contrast enhancer, the research suggests a convolutional neural network learning method [31].

A wavelet-based high-resolution image enhancement method for improving the edge smoothness of a satellite image is presented in the paper [33].

C. Image Classification

The amount of data in several sectors, including e-commerce, automotive, healthcare, and gaming, has increased, and technology companies are increasingly interested in picture classification. [46]. A sort of image processing method called image classification makes use of feature data from images to identify various objects [65]. Image classification aims to identify the class to which an input image belongs. For humans, this is not a big matter, but training computers to see is a challenging task that has drawn significant research attention. Both traditional computer vision and Deep Learning (DL) algorithms have been developed to address this issue.

In several areas, including remote sensing, biometry, biomedical pictures, and robot navigation, classification is a crucial task. In this research [65], the use of convolutional neural networks (CNNs) for captioning and image categorization is examined. These tasks are essential to contemporary computer vision and have numerous uses.

The representational unit of an image is the pixel. Pixels are categorized into various classes in image processing. The image classification process includes picture pre-processing, image sensors, object recognition, object segmentation, feature extraction, and object classification. The classification is done using a variety of algorithms. The study published in [66] explores Support Vector Machine (SVM) active learning, which was a hot topic at the time. It also introduced a novel concept by merging spatial data from a sequential trial method with spectral data. Two of the photos had a great resolution, according to the results. They proposed a novel technique for fast-identifying photos in this publication [67].

On a real-world dataset, our method, which works by repeatedly constructing fuzzy rules based on the most important image attributes, has demonstrated encouraging results. This research proposes [68] a new and general method for incorporating prior information into deep learning. Individual classification is superior to collective classification.

Four categories of picture classification techniques that have been proposed are as follows: [2].

1- With the Morkov model and the Bayesian model, image categorization using statistics is a common statistical technique that is based on the principle of least error.

2- Using local traits, traditional colors, and textures to classify images

3- Image classification based on shallow learning.

4- Using deep learning, classify images.

IV. RESEARCH GAP

After researching several strategies, it can be said that each technique has advantages over the others. Some procedures are more accurate, while others are more efficient. Image processing techniques have advanced significantly.

When it comes to gathering information for natural disaster management, military target recognition, meteorology, urban planning, harm assessment, and change detection, among other things, satellite image retrieval could be a significant issue [69]. The majority of modern image retrieval techniques are still unable to produce results with high retrieval accuracy and little processing complexity.

The major aims of image enhancement are to enhance an image's visual appeal and give computer vision algorithms a better representation of the image. For each purpose, such as underwater photography or medical images, several techniques and methods are ideal for picture improvement. There is no approach to enhancing images that fit everywhere. The main cause of this is the fact that there are so many different factors to consider, such as fog in pictures and movies or the fact that medical images are typically grayscale. A crucial step in the processing of microscope images is contrast enhancement, which demands careful attention. For solving image classification problems Further studies are required to investigate the relationship between each layer of the deep convolutional neural network and the visual nervous system of the human brain, as well as how to build the deep neural network incrementally, like humans do, to compensate for learning and improve understanding of the target object's details. The future scope is to enhance classification accuracy through research and learning to reduce running time.

V. Conclusion

Image processing has been the subject of extensive research and development for many years. Techniques for image processing are always changing. Everyday activities become more and more focused on images. Digital TV (including broadcast, cable, and satellite TV), Internet video streaming, digital cinema, and video games are examples of applications that have profited greatly [70]. Imaging technologies are used in a variety of industries besides entertainment, including digital photography, video conferencing, video monitoring and surveillance, and satellite imaging, as well as more specialized ones like healthcare and medicine, distance learning, digital archiving, cultural heritage, and the automotive industry. This article gives clear information on the many approaches and models used in image processing.

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