Analytical Study on Real Time Digital Image Processing Techniques

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Abstract

Image processing is a widely used practical computer technique with significant theoretical importance in the area of signal information processing. The inability to perform image processing in real time might have disastrous consequences; as a result, studying and researching real-time image processing techniques is of the utmost importance. The field of digital image processing has grown rapidly and is currently employed in many different fields for a broad variety of jobs. s. To enhance a picture and extract useful data from it, image processing involves digitizing the image and performing various operations on it. Digital image processing methods have been used to analyses photos from many different fields. Using image processing, digital photos may be improved upon. Picture processing makes use of a wide variety of methods, including grayscale conversion, image segmentation, edge detection, feature extraction, and classification.

Keywords: *Real Time Image Processing; Methods of Image Processing; Techniques of Image Processing; Applications of Image Processing; Image Enhancement.*

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1. INTRODUCTION

Images permeate every aspect of our existence. While there are various applications for image processing, the most crucial one is recognition. In cases when picture data is erroneous, such as in medical imaging, it is necessary to alter and enhance the images so that the doctor can make the most informed treatment choice possible. Others, like the treatment of medical photos to identify illnesses, need some pre-processing so that the computer can analyses the image and make the proper conclusion without the human aspect. From these instances, it is clear that real-time image processing plays a crucial role in our ever-changing everyday lives. For the purposes of this study, we will be making use of Real-Time processing, which consists of the following two components. First, there are "Hard Real-Time" systems, such as those used in aero plane surveillance, where even a second's delay might result in catastrophic failure and even loss of life because of the extreme time sensitivity of the system. The second type of real-time system is known as a soft real-time system, and like hard real-time systems, it has time constraints on the tasks it performs. However, unlike hard real-time systems, soft real-time systems can tolerate a small or a few delay times before the system crashes or suffers significant losses.

The term "digital image processing" refers to a specific method through which digital photos are processed by an algorithm on a digital computer. Many benefits are unique to digital image processing, a subfield of digital signal processing. Because of this, a broader set of algorithms may be used to the input data, potentially preventing issues like noise and distortion from building up as processing progresses. Since pictures may be specified in at least two dimensions, digital image processing can be represented as a multidimensional system. The advancement of computing technology, the growth of mathematics (particularly the development and improvement of discrete mathematics theory), and the rising demand for applications in fields as diverse as environment, agriculture, military, industry, and medicine all have significant impacts on the creation and development of digital image processing.

We rely heavily on digital photos in our daily lives. Each minute, millions of digital photographs are posted online. These numbers, often binary, constitute a two-dimensional picture. Medical imaging, video surveillance, forensics, remote sensing, etc., are just few of the many potentials uses for digital pictures. Using different image processing methods, automated analysis of pictures and data is becoming more important. The areas of image enhancement, modification, and analysis all rely heavily on advances in image processing and computer vision. In order to enhance the quality of digital photos, image processing analyses and modifies the data

included inside the images themselves. The primary benefits of digital image processing systems are their adaptability, repeatability, and accuracy in maintaining the original data.

Commonly, when people talk about "image processing," they mean digital image processing. Analog and optical image processing are also included in this context. This article presents a comprehensive analysis of the role of image processing in computer vision. Imaging is the process of taking pictures. Optics, computing, mathematics, surfaces, physics, and even visual psychophysics all play a role in digital image processing (DIP), making it a truly interdisciplinary area of study. Image processing has many uses in the field of computer vision, including remote sensing, feature extraction, face detection, fingerprint detection, optical sorting, augmented reality, microscope imaging, lane departure warning systems, non-photorealistic representation, medical image processing, and morphological imaging. Multiple smaller pictures, or "regions," may be found inside a larger image. Groups of things in an image often serve as the foundation for their own distinct area. In most cases, digital versions of the photos are required for processing.

In order to digitize a picture, its constituent parts are separated into discrete lattices and quantized to the same number of bits. The digital picture goes through some processing. A digital picture is shown by first being transformed into an analogue signal, and then being scanned onto an output device. Computer vision and computer graphics are two subfields of image processing that are extremely closely connected to one another. In computer graphics, unlike in most animations, visuals are not captured by imaging equipment from natural situations but rather are physically created by hand using surroundings, physical models of things, and lighting.

2. LITERATURE REVIEW

Ms. R. Malath et.al (2018) There have been significant advancements in image processing thanks to the use of computers and associated technologies. Numerous applications have made use of digital image processing methods to extract patterns from digital pictures and to recognize characters in photographs. CAD systems enable radiologists in identifying lesions and masses in medical pictures produced by medical equipment. Researchers interested in real-time image processing will find this study helpful for its thorough examination of the many steps involved in digital image processing.

Shonima Vasudevan (2017) Digital image processing is a fast expanding and more important topic in computer science. In this article, we examine the fundamentals of image processing and its many fields of application. These uses could vary from one another. The purpose of this article is to use examples from the aforementioned reviews to introduce the reader to the fundamentals of image processing. There are two primary uses for digital image processing that will be described. Image data may be used to enhance human perception of visual information, as well as autonomous machine perception and efficient storage and processing. Pixels are the discrete digital values used to represent a picture in a digital medium. Opacity, color, grayscale, and elevation are all quantified by pixel values. When a picture is digitized, it becomes a representation of the world around it. Some procedures are performed on the picture to complete the processing. In this article, we will look at some of the fundamentals of the image processing field. Acquiring a picture is the same thing as perceiving it. To "enhance" a picture is to increase its visual quality. Restoring an Image means just that. A smaller file size may be achieved by image compression by reducing the amount of data a picture contains. Additionally, extraction/selection methods fall within this kind of method. Image processing has many important uses, including the arts, medicine, industry (inspections, biometrics, GIS), law enforcement (facial recognition, gesture recognition), and the human-computer interface (HMI).

Mukul et.al (2018) Submarine cables allowed for the transmission of photographs from London to New York, marking one of the first uses of digital images in the newspaper business. When the Bart Lane cable image transmission system was first put into use in the early 1920s, the time it took to send a picture across the Atlantic was cut from more than a week to less than three hours. Images were sent via cable and then decoded at the receiving end using specialized printing equipment. The selection of printing companies and the distribution of intensity levels were two of the first issues with increasing the visual quality of these early digital photos. As a matter of fact, the development of digital computers and of supporting technologies, such as data storage, display, and transmission, has been crucial to the growth in the area of digital image processing. Each pixel in the digital picture has a specific position and a set of values. Pixels, picture elements, and image elements are all names for the same thing. A digital image's smallest distinguishable feature is its pixel resolution. Digital image processing involves taking a picture of the text area, processing it, separating out the letters, defining them in a format that a computer can understand, and then identifying them.

T Prabaharan et.al (2022) In order to make high-quality goods in a short amount of time, quality inspection and assessment play a crucial role. Computer-aided quality estimate of goods across engineering disciplines is a positive development. One of the most promising fields, image processing is used in product quality assessment, where the difficult challenge is recognizing the item and extracting features. The authors of this study set out to provide a high-level summary of the ways in which image processing has been put to use in several branches of engineering, breaking down the process into its component parts: picture capture, the area of interest, and fault diagnosis. The construction, fluid-flow, thermal-imaging, medical, fruit-and-vegetable, and rock-carving industries are the primary focus of this article. Incorporating image processing into a variety of industries allows for the production of higher-quality goods with less time and money spent on inspection.

R. Ravikumar et.al (2019) In many images processing uses, images are the most readily apparent input. The future of human-computer interaction will be profoundly altered by image processing. Complex aspects of a picture may be extracted using any one of a wide variety of software programmers, hardware devices, and methods of image processing. In contrast, modern image processing may go beyond multidimensionality to reveal the true contents of a picture. While there are several technologies at work on live pictures, image processing is at the very heart of the matter. An overview of image processing applications, tools, and techniques is presented in this study.

3. RESEARCH AND METHODOLOGY

The following are the phases of a digital image processing. The block diagram of digital image processing is as shown in the figure 1

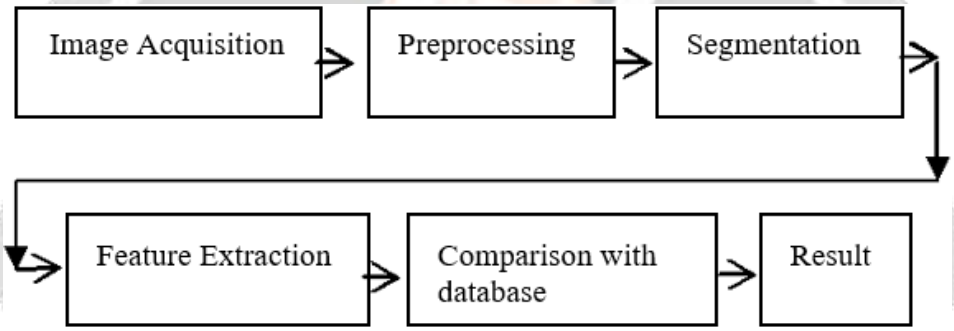

Figure 1. Block diagram of digital image processing

A. Image Acquisition

Considered the groundwork for further processing, it is the initial stage in digital picture creation. The digital picture is provided as part of the image capture process. Common pre-processing steps in the picture capture pipeline include scaling and rotation. A picture may be entered via a scanner, a digital camera, or even an aerial camera. This picture has to be of excellent quality, with a high resolution to aid in accurate image analysis.

B. Preprocessing

Initial processing on the provided image is required. Images may be improved using pre-processing techniques by eliminating artefacts and boosting sharpness. Since high-quality photographs take longer to process, it's important to reduce their file size beforehand. Next, the color image is converted to a grayscale one, with the goal of reducing the amount of information needed for each individual pixel. It is necessary to provide a single intensity level per pixel since "grey" is attained when the red, blue, and green components all have the same value.

C. Edge Detection and Segmentation

The term "edge detection" is used in the field of image processing to refer to the procedure of locating the borders of discernible objects in a given image. It works by sensing abrupt changes in light levels. Segmenting images and extracting useful information from them rely on a technique called "edge detection," which has applications in domains as diverse as image processing, computer vision, and machine vision. Cutting up an

image into smaller parts, or segmenting, is a common task in computer vision. The goal of segmentation is to improve the interpretability and efficiency of an image's representation. Image segmentation is a method for locating objects and boundaries (lines, curves, etc.) in photographs. Labeling each pixel in a photograph such that pixels with the same label have similar characteristics is image segmentation.

D. Image Restoration

Visual quality enhancement is the focus of the area of picture restoration. The process of restoring damaged images sometimes use mathematical or probabilistic models. Several filters, both pre-existing and ones that may be made, can be used to restore and improve the quality of an image.

E. Output Image

Several images processing techniques, including morphological operation, may be used to isolate the topic of interest in a digital photograph.

4. DATA ANALYSIS

The following table gives the analysis of techniques and methods used in research papers on image processing and identification.

Sr. No	Paper Title	Techniques	Addressed Issue
1	A Smart Phone Image Processing Application for Plant Disease Diagnosis [1]	Plant disease recognition technique; Matrix bgw2 is constructed	Image processing that analyses the color features of the spots in plant parts.
2	Scaffolding Progress Monitoring of LNG Plant Maintenance Project using BIM and Image Processing Technologies [9]	BIM model	This method, combining object recognition techniques, can rapidly estimate the total number of scaffolding components from images
3	Detection of unhealthy region of plant leaves using Image Processing and Genetic Algorithm [5]	Image acquisition; Preprocessing of input image; Segment the components using genetic algorithm.	The optimum output was obtained with less computation efforts. The framework demonstrates the effectiveness of proposed calculation in acknowledgment and order of the leaf infections.
4	Detection of unhealthy region of plant leaves using Image Processing and Genetic Algorithm [5]	Aerobot; K-means; HSV; ANN; BPNN; CCM; Neural Network; SURF; RBF; SIFT; RDI; GLCM; PCA; SGDM	Aerobot; K-means; HSV; ANN; BPNN; CCM; Neural Network; SURF; RBF; SIFT; RDI; GLCM; PCA; SGDM
5	Color Image Segmentation using Morphological edge Detector Algorithm [14]	ISKMO Algorithm Combination of K-means and edge detection operator	The process shows proper segmentation process and segmentation for noise content image. The combination of algorithm has reduced the detection of false edge in segmentation result.
6	Image classification using support vector mechanism and artificial neural network [12]	ANN algorithm SVM algorithm	ANN classify the result based one by one image feature vector. SVM integrate all result of ANN
7	GPU based parallel processing for plant growth analysis []	Graphic processing unit (GPU) Thresholding algorithm	Give best thresholding algorithm to get partition of object and environment. The parallelism processing gives more efficient time in execution result
8	A study on image segmentation using different type of k-means	k-mean clustering method	The paper gives different method or formula to find k-mean value to get better results.

	clustering [13]		
9	Content based image retrieval using feature extraction [11]	Feature extraction using color, shape, texture	Extraction of data from image using its color and texture
10	Automated identification of two growth stage for rapeseed plant: Three leaf and four-leaf stage [4]	Active shape method -point distribution -local grey texture method	Used pattern recognition method to get data and process for entire geometry of plant
11	A Study and Comparison of Different Image Segmentation Algorithms [2]	Otsu's algorithm, K-means, quad tree, Delta E, Region growing and ft algorithms.	Image segmentation process, and algorithm for the method based on thresholding, parallel processing clustering, edge detection, histogram analysis.
12	An Effective Algorithm for Edges and Veins Detection in Leaf Images [3]	RGB Color, Edge detection, Vein Detection Algorithm	By examining the sudden change in the intensity values in leaf images the leaf edge can be easily detected.
13	Contribution Of Texture and Red-Edge Band for Vegetated Areas Detection and Identification [6]	Edge Detection	Automate these photo-interpretation tasks. It especially accentuates on the assurance of the most appropriate information to adapt to these two order issues
14	Generalization of Otsu's Binarization into Recursive Color Image Segmentation [7]	Otsu's Algorithm	Otsu's segmentation method, in view of histogram examination, is broadly utilized as a part of different applications. The method segments an image by maximizing the variance between segments and, simultaneously, minimizes the variance within the segments.

5. CONCLUSION

A plan for the algorithm's hardware implementation in image processing is provided. With this study, we have succeeded in our goal of providing a comprehensive overview of real-time image processing methods, strategies, and applications to aid researchers in this area. Computer scientists aren't the only ones who have discovered the benefits of digital image processing; researchers in other branches of Engineering and Technology have done the same. In this work, we give a comprehensive analysis of image processing and its many practical uses. We have covered the foundations of image processing, including images, image analysis and comprehension, image transforms, compression techniques, optical character recognition (OCR), and their applications, which include video and 3D graphics stability, visual content analysis, pattern gratitude, biometrics, remote sensing, statistical image processing, multimedia interaction and virtual reality, face detection, and medical image processing. Image datasets with leaves, fruits, and objects benefit most from the SIFT feature extraction approach, whereas image datasets with flowers and plants benefit most from the HSV color and shape extraction methods. Various image processing methods are analysed in this research. This article provides a summary of the many image processing techniques that are relevant to this topic.

6. REFERENCES

1. Ms. R. Malath et.al (2018) A Research Survey on Real Time Image Processing Techniques ISSN: 1314-3395
2. Ms. R. Malath et.al (2018) A Basic Study of Image Processing and Its Application Areas ISSN: 2278-0181
3. Mukul et.al (2018) The Origins of Digital Image Processing & Application areas in Digital Image Processing Medical Images SSN (Online): 2278-0181
4. T Prabaharan et.al (2022) Studies on application of image processing in various fields: An overview doi:10.1088/1757-899X/961/1/01
5. R. Ravikumar et.al (2019) Digital Image Processing-A Quick Review ISSN:2457-0249

6. D Kalyani et al, ―An Improved Lung Cancer Prediction System using Image Processing", International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Vol.8, Issue-4, November 2019.
7. S. Padmappriya, K.Sumalatha, "Digital Image Processing Real Time Applications", International Journal of Engineering Science Invention (IJESI), ISSN (Online): 2319 – 6734,pp. 46 -51,2018.
8. Shailendra Kumar Dewangan, "Human Authentication Using Biometric Recognition‖, International Journal of Computer Science & Engineering Technology (IJCSET), ISSN: 2229-3345, Vol. 6, No. 4, pp. 240-245, April 2015.
9. Mostafa Bayati and Reza Fotouhi (2018), "A Mobile Robotic Platform for Crop Monitoring, Advances in Robotics‖, 7(1), 186-191
10. Rajendra Akhil Kumar, Gone Sri Vaishnavi, Pilli Sathavardhana Rao and Diwakar. R. Marur, "Crop Monitoring using Visual Sensors and IOT" SSRG International Journal of Electronics and Communication Engineering volume 4 issue 4 (2017)
11. Noorpreet Kaur Gill, Anand Sharma, ― Vehicle Detection from Satellite Images in Digital Image Processing "International Journal of Computational Intelligence Research, ISSN 0973-1873 Vol 13, No. 5, pp. 697-705, 2017
12. R Sindhoori, "Digital image processing. Multi feature face recognition in PSO –SVM‖, SSRG International Journal of Electrical and Electronics Engineering, volume1 issue 3 May 2014
13. Pratishtha Gupta, Manisha Rathore,Saroj Kumari,"A Survey Of Techniques And Applications For Real Time Image Processing", Journal of Global Research in Computer Science, Volume 4, No. 8, August 2013
14. Ranu Gorai (2016), A Survey of Digital Image Processing, International Journal of Research in Engineering, Technology and Science, VI (Special Issue)2.
15. Jangala Sasi Kiran, N Vijaya Kumar, N Sashi Prabha and M Kavya (2015), A Literature Survey on Digital Image Processing Techniques in Character Recognition of Indian Languages, International Journal of Computer Science and Information Technologies,6(3), 2065-2069