A Study on Identification, Categorization and Applications of Image Processing Systems

[1]Akash Dey,[2]Sreetoma Mukherjee,[3]Anirban Bhar, [4]Soumya Bhattacharyya

[1,2]B. Tech student,Department of Information Technology, Narula Institute of Technology, Kolkata, India.
[3,4]Assistant Professor, Department of Information Technology, Narula Institute of Technology, Kolkata, India.

***Abstract*—The field of image processing is always fascinating because it produces improved visual data for human simplification and processes image data for transmission and presentation of machine perception. This paper studies different uses of image processing, the representation of various types of images in the matrix form, the scope of image processing and the various stages and methodologies involved in a typical image processing system. This paper also illustrates the role of artificial intelligence and machine learning in image processing and the applications of it in the modern world for autonomous machine perception in the fields of biotechnology in support of healthcare.**

***Keywords*—Image Processing, Artificial intelligence, Biotechnology, Machine learning.**

I. INTRODUCTION

Image processing is a technique in which some operations are performed on the raw image, to either enhance the image or extract some useful information from it. The raw images may be received from cameras/sensors of satellites, space probes, aircrafts or pictures taken in normal day to day life.There are two methods available in image processing, namely analogue image processing and digital image processing. Analog image processing is alteration of an image by electrical means. Examples of analogue images are television images, photographs etc. In the case of digital image processing, alteration of digital images is done by computers.
It is possible to define a digital image as a 2D array or function F (x, y), where x and y are spatial coordinates and the amplitude of F at any given pair of coordinates is known as the intensity of grey level [1]. The is defined over a grid and each grid location is called a pixel. In a digital image, all values associated with f, namely x, y and amplitude are finite discrete quantities. So it is represented by a finite grid and each intensity data is represented by a finite number of bits. For example, a binary image is represented by one bit and grey level image is represented by 8 bits.Image processing is among the rapidly growing technologies and it is used in various applications such as remote sensing, medical imaging, forensic studies, non-destructive evaluation, computer/machine vision, pattern recognition, graphic arts, video processing and many more [2].

II. PREVIOUS WORK

Image Processing is such a robust and versatile technology, that it was has been researched well in almost all fields. Various application and implementations of the technology have been researched thoroughly. For example, image enhancement [3,4], face recognition [5] and Automatic Target Detection [6]. Image processing have also been very popular in fields of application such as traffic monitoring [7]. Moving object tracking using image processing is also an application, which is similar to traffic monitoring [8]. There are two different approaches to moving object tracking, namely recognition-based tracking and motion-based tracking [9]. In the recent years, the application of image processing systems has expanded out to the biomedical fields as well [10, 11, 12]. So, as we can see, image processing has a vast area of application.

III. IMAGE PROCESSING AND IT'S APPLICATIONS

The use of image processing technologies in fields of biotechnology and healthcare can be a blessing for us. Detection of disease early by analyzing the diagnostic reports such as X-Rays, CT scans, MRI scans etc. by implementing image processing technologies along with machine learning can increase the efficiency, save time and take some workload off the doctors and nurses. Another application is the automated detection and classification of cancer by analyzing the microscopic biopsy images. The system flow should start with the program taking the image of the biopsy as the input, then analyzing the image, then classifying it into types of benign, mild and malignant. The output report should include the classification type, along with the pattern and reasons for choosing the classification type. This should be done for the doctors and nurses to check the report for further accuracy of results. The image processing architecture for the detection of cancer by image processing system and classification of its type after careful analysis.The purpose of this annotation is for a clear understanding of the process and the steps to be followed. Image processing is very much popular due to its versatility in analyzing, finding out abnormalities in reports and classifying the results. The assortment of steps to be performed is as follows:

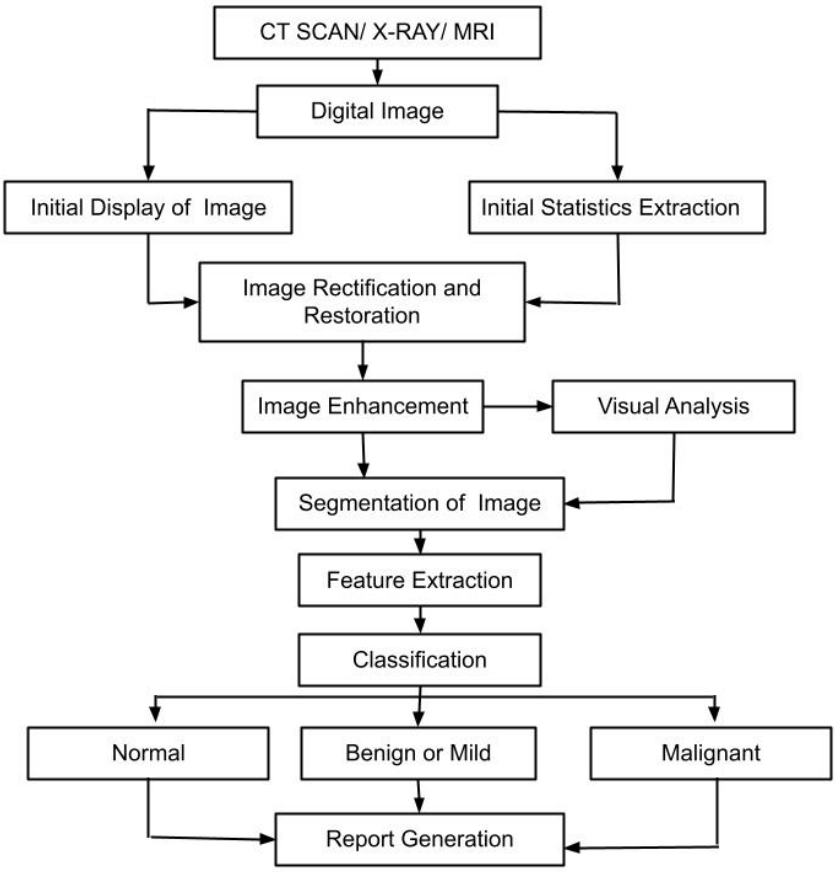


Figure 1: Flowchart to identify malignancy from digital image

i) Image Acquisition— It is the process of accepting the Computed Tomography (CT scan), x-ray, or biopsy images as inputs to the program. It is the first step for any image processing system.

ii) Image Enhancements— This Image Enhancements process is used for making image more clear and enhance its properties for efficient recognition by the software's underlying machine learning technology. To get more accurate results in image segmentation, the enhancement of the image is required. Various techniques can be used for this process, such as Gauss filter, edge detection, Contrast-stretching Transformation (CST), standard logistic (SL) function to enhance global contrast, Logarithmic Image Processing (LIP).

iii) Image Segmentation—Image segmentation is a technique that separates pictures that are comparable from different angles and converts them into paired frames for preparation. The first step in many image processing processes is the segmentation process. Object representation, characteristic, and detail estimation are all included in the procedure. Higher order tasks follow the grouping of objects. Consequently, classifying a picture, picturing a region of interest inside an image, and describing it all play important roles in image segmentation.

iv) Feature Extraction— It is nothing, but the analysis of the image for certain patterns, values and attributes such as wavelets coefficient, and value histograms, for the conclusive result and further classification.The extraction of image features using color-based feature extraction is a crucial approach, despite the fact that there are many other ways that have been employed.Since texture is a significant and popular method of identifying the features of images so that they may be utilized for recognition and interpretation, some of the images can be processed using feature-based methods.

v) Classifications of Tumor—The labelling of a pixel or a group of pixels according to its grey value is known as classification[16,17]. One of the most popular ways to obtain information is through classification. Multiple features are typically employed for a set of pixels in classification, i.e., numerous photos of a specific object are required. This process is based on the premise that imagery of a certain geographic area has been gathered from several electromagnetic spectrum regions and is in excellent quality. The majority of information extraction techniques use specialized algorithms that carry out various sorts of "spectral analysis" to analyses the spectral reflectance qualities of such imagery. Either of the two approaches can be used to accomplish multispectral classification, i.e. Supervised or Unsupervised.

This is the final step of the process, where the classification of the abnormality (if found) is determined based on its severity. As mentioned above, the results can be normal, mild, benign and malignant. For instance, if we are taking lung cancer into consideration as the test case, the most common classifiers for analyzing lung cancer are SVM Support Vector Machine [13], K-NN K-nearest neighbors [14], Decision tree and Artificial Neural Networks (ANN)[15]. The performance of the complete classification algorithm is evaluated using the parameters of suggested system specificity, accuracy, and sensitivity. The comp. assisted diagnosis model (CAD) compares the results of the classification step for the diagnosis of lung disease (LDD) and generates the final results. The image processing system can also be in self-driving cars as well. More specifically, the detection of roads or lanes.

Upon receiving the image from the front camera, why do some modifications to it using python. The steps followed are listed below:

1. **Distortion correction**

When a camera views 3D things in the actual world and converts them to a 2D image, image distortion happens. This transition isn't always accurate, and distortion might cause an object to appear to alter in size, shape, or location. In order to provide the camera with an accurate view of the image, we must correct this distortion. This is accomplished by utilizing the cv2.calibrateCamera() method and many photos of a checkerboard taken with a camera to compute a camera calibration matrix.When each point in the visual plane is magnified differently in size, distortion results. Distortions are correctable digitally because they do not blur the image. The magnification varies with distance from the optical axis because lens distortion is rotationally symmetric. Three basic types of distortion are:

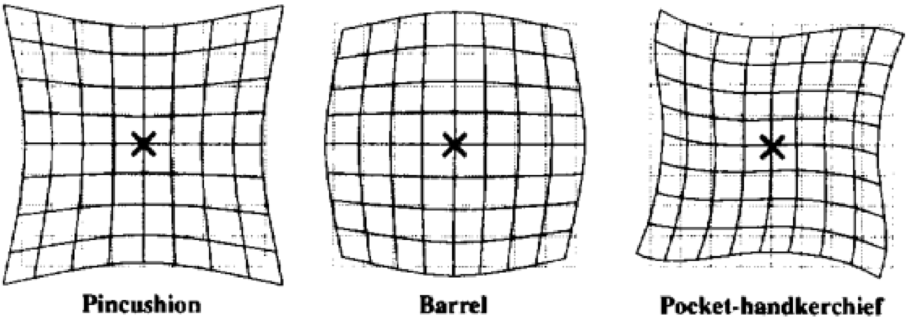


Figure 2: Basic types of distortion

2. Creation of binary image

We can begin our analysis now that we have the original image. In order to clearly recognize the object of interest on the road, in this example lane lines while disregarding the others, we need to investigate various approaches. I did it in two different ways:

Using Sobel operator to compute x-gradient

Sharp color shifts in a black-and-white image can be seen using the gradient of the image. The ability to find edges in an image is a very helpful skill. Since we typically have a lane line in either yellow or white on a dark road in a road image, the x-gradient can be quite helpful.

Sample Image 1

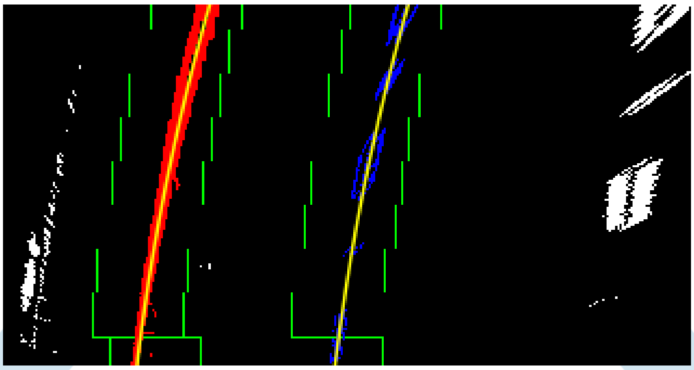
3. Birds eye view image

We apply a perspective transform to convert the image to a bird's eye view after the thresholding procedure. This is done so that we can determine the lane's curvature and how to drive the car from this top-down perspective.

Sample Image 2

4. Fit curve lines to the bird eye view image

We use a histogram of the bottom half of the image to locate probable left and right lane markers in order to more accurately determine where the lane is.



Sample Image 3

5. Plot result back down onto the road such that the lane area is identified clearly

Using cv2.warpPerspective once more, we can warp the lane lines back onto the original image after we have detected the lane lines and fitted a polynomial to them. To display the lane lines on the undistorted image, we additionally perform a weightedadd.

Sample Image 4

IV. Future Scope and Conclusion

As mentioned earlier, image processing is an extremely robust technology, which can have various applications in all fields. Already, so much has been done, but still there is always room for improvement. Image processing when combined with artificial intelligence and machine learning technologies can be extremely useful. For example, real time removal of fog from foggy videos- this can help prevent accidents and save lives of the drivers who work in foggy conditions. Recognition of traffic signs from images based on colour and shape, if implemented into the AI of the cars, can help beginner drivers to get indications about their mistakes, and again prevent accidents. Self-driving cars could implement this technology as well. Image processing systems can also be used to detect feeling of a face, by extracting the facial features. In biometric identification, for example Iris recognition, image processing systems can be used. This is mainly used in border security checks to identify a person, based on the unique pattern of their iris of the eye. Although, this technology has been around for quite a while, improvements can definitely be made.

References

[1] Hegadi, Ravindra. (2010). Image Processing: Research Opportunities and Challenges.

[2] Basavaprasad B, Ravi M, IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163ISSN: 2321-7308

[3] Sankar K. Pal and Robert A. King: Image Enhancement Using Smoothing with Fuzzy Sets, IEEE transactions on systems, man, and cybernetics, vol. SMC-1 1, No. 7, July 1981

[4] HarisAčkar, Ali Abd Almisreb, Mohamed A. Saleh: A Review on Image Enhancement Techniques, Southeast Europe Journal of Soft Computing,VOL.8 NO.1March 2019 - ISSN 2233

[5] Bilal Salih Abed Alhayani, Prof. Milinf Rane: International Journal of Electronics and Communication Engineering & Technology (IJECET), ISSN 0976 – 6464(Print), ISSN 0976 – 6472(Online), Volume 5, Issue 5, May (2014), pp. 80-90 © IAEME

[6] Jia Wang, Chen Liu, Tian Fu, Lili Zheng: Research on automatic target detection and recognition based on deep learning- Journal of Visual Communication and Image Representation, Volume 60, April 2019, Pages 44-50

[7] Akoum, Al. (2017). Automatic Traffic Using Image Processing. Journal of Software Engineering and Applications. 10. 765-776. 10.4236/jsea.2017.109042.
[8] S R, Balaji & Karthikeyan, Dr. (2017). A survey on moving object tracking using image processing. 10.1109/ISCO.2017.7856037.
[9] Mukesh Tiwari, Dr. Rakesh Singhai,International Journal of Computational Intelligence Research ISSN 0973-1873 Volume 13, Number 5 (2017), pp. 745-765
[10] P. Suetens, Fundamentals of Medical Imaging, Cambridge University Press, 2002.
[11] P. F. Van Der stelt and QwilG.M.Geraets, "Computer aided interpretation and quantitation of angular periodontal Bone defects on dental radiographs", IEEE Transactions on Biomedical engineering, 38(4), April 1998. 334-338.
[12] M. A. Kupinski and M. Giger, "Automated Seeded Lesion Segmentation on Digital Mammograms," IEEE Trans. Med. Imag., Vol. 17, 1998, 510-51 7.
[13] Kollabhanu Prakash, Lakshmi Kalyani,Naga Pawan, "Analysis of Mammography for Identifying Cancer Cells Using Convolution Neural network", IJATCSE March –April 2020. https://doi.org/10.30534/ijatcse/2020/44922020
[14] Gray, Givens, Keller, J.M., M.R. A fuzzy K-NN algorithm, Transaction IEEE on System, Man, and Cybernetics, 1985. SMC-15(4): p. 580-585
[15] Murty, Rao, M.V., N.V., Early Lung Cancers Detections by using Radial Basis Functions Neural Network, 2(8), 2015
[16] Computer Image Processing And Recognition - Ernest L.Hal, Academic Press, 1979.
[17] Digital Image Processing - Chellappa, 2nd Edition, IEEE Computer Society Press, 1992.