APPLICATIONS OF IMAGE PROCESSING: A REVIEW

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Abstract- Image processing plays an important role in today's world .In this review paper, different applications of image processing has been explained like medical imaging, license plate detection, defect detection, edge detection, character recognition, enhancement, filtering for noise reduction etc.

I. INTRODUCTION

Image processing is a form of signal processing having an image as input and output will be an image or a set of characteristics or attributes related to the image. Most of the image processing technique involve the image as a two-dimensional signal .Image processing involve different techniques like image enhancement, image restoration, image compression etc.

II. APPLICATIONS OF IMAGE PROCESSING

There are many applications of image processing which are explained as follows:

A.Medical imaging

Medical imaging is the technique and process used to create images of the human body (or parts and function thereof) for clinical purposes. It refers to a number of techniques that can be used as non-invasive methods of looking inside the body. This means the body does not have to be opened up surgically for medical practitioners to look at various organs and areas. It can be used to assist diagnosis or treatment of different medical conditions. Medical imaging is one of the most important applications of image processing.

B. License Plate detection

License plate detection or recognition is one of the major applications of image processing. This kind of application is used in parking, access control, tolling, stolen cars, airport parking to capture the plate numbers and images of the cars/vehicles. In license plate detection method, first step is to enhance the input image by doing filtering and then go for LP localization process involving histogram and mathematical morphology process. Second step is using LP extraction, each character of the LP must be extracted for the recognization process. And after then image thresholding and classification of connected components and region extraction have been done [6].

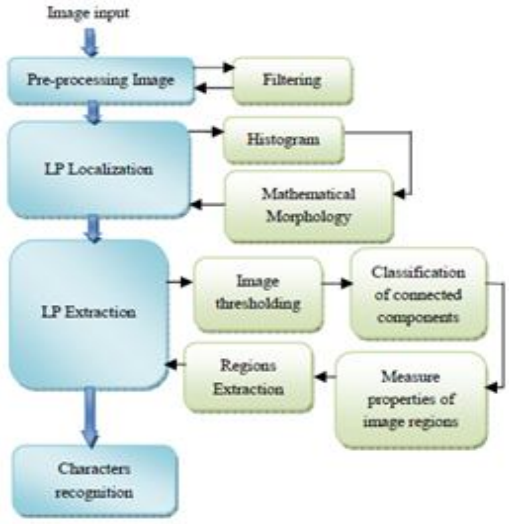


Fig.1 Process of license plate detection [6]

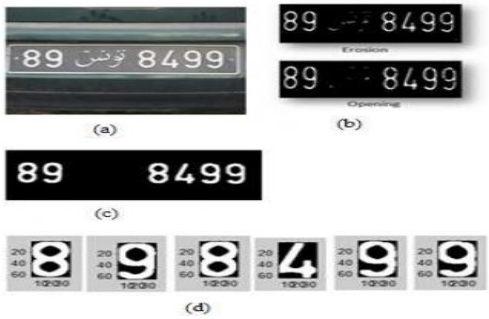


Fig. 2.a) License plate localization b) Morphological operation c)Keep only numeral characters d) Extraction region's characters [6]

C. Defect Detection

PCB defect detection is one of the important applications of image processing. Image subtraction is a referential method, compare some feature of the board being tested to a 'perfect' image stored in the system memory. Image subtraction is a kind of pixel subtraction process ,where by the numeric value of one pixel or the complete image is subtracted from the another image .The image subtraction operator takes two images as input and third image as output , whose pixel values are simply those of the first image minus the corresponding pixel values from the second image .Image subtraction method is performed in order to get the differences between the two images[2].The method compares both the images

pixel-by-pixel using XOR logic operator (seeTable 1) .The resulting image will have defects.

TABLE 1
Truth table of XOR logic operator

Bit 1	Bit2	Output
0	0	0
0	1	1
1	0	1
1	1	0

From the table 1, it is concluded if the bit1(pixel value) of reference image is not equal to pixel value of test image(bit 2) then there will be error or defect will be detected .and if both pixel values of images are same, there will be no defect found.

The subtraction of two images is performed as:

$$A(i,j) = A1(i,j) - A2(i,j) \ldots\ldots (1)$$

where A is the output image
A1 is the reference input image
A2 is the inspected input image

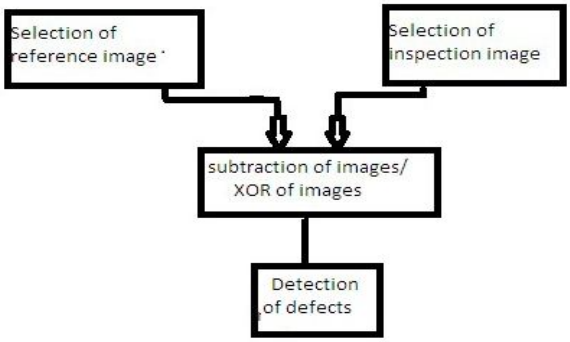


Fig.3. Flowchart showing image subtraction method for PCB defect detection

Fig. 4 shows template image and Fig.5 shows defective image, having some defects and output is shown in Fig. 6, which shows detection of defects.

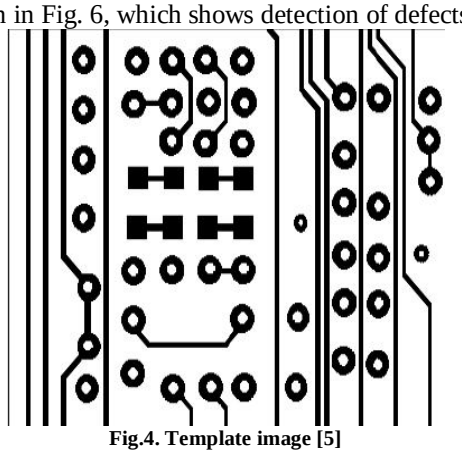


Fig.4. Template image [5]

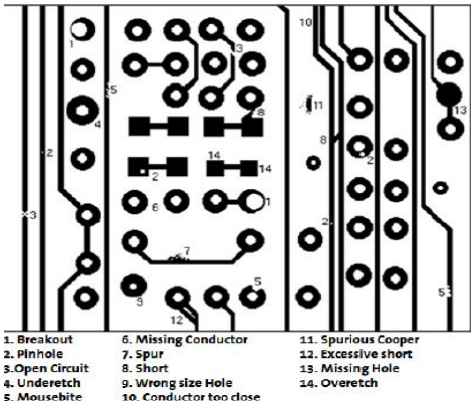


Fig.5. Defective image [5]

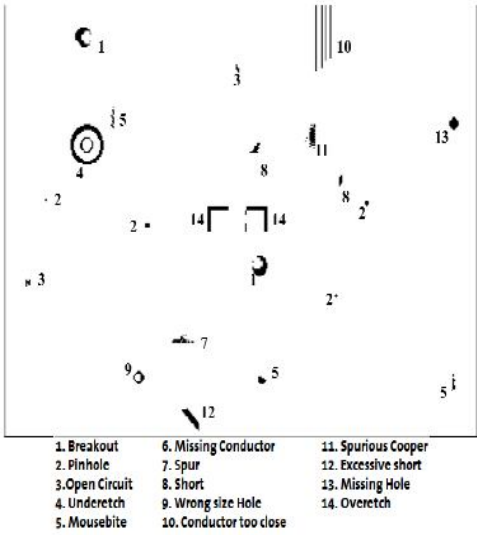


Fig.6. PCB defect Detection using image subtraction method [5]

D. Edge detection

The main purpose of edge detection is to divide the image data according to the sharp intensity changes in an image resulting from discontinuities in depth or surface orientation. Different edge detector have been proposed such as Sobel, Robert, DoG etc. which is either based on finding the first order derivative maxima or minima or zero crossings in the second order derivatives of pixel intensity in an image. The Sobel operator performs a 2-D spatial gradient measurement on an image.



Fig. 7. Original image

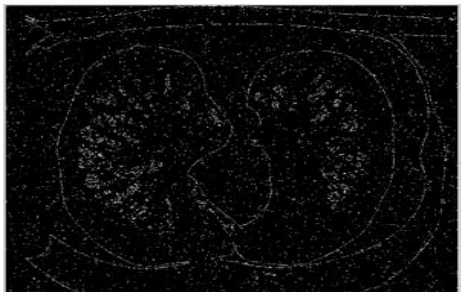


Fig.8.Edge detection using sobel operator

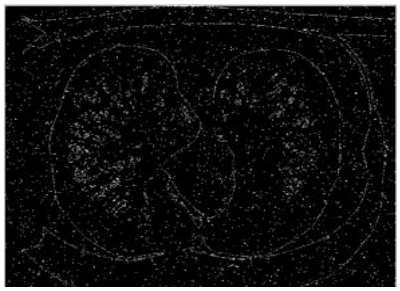


Fig.9. Edge detection using Prewitt operator

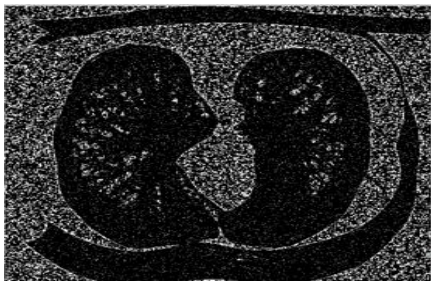


Fig.10. Edge detection using canny operator

E. Recognition of handwritten digits

Automatic handwriting recognition has a variety of applications at the interface between man and machine [1]. In this application of image processing, the ten digits of English language are divided into two groups. Group 1 consists of digits wit blobs with/without stems. The group consists of digits- 0, 4, 6, 8, 9 and group-2 consists of digits with only stems having digits-1, 2,3,4,5,7. The blobs are identified by region filling method.

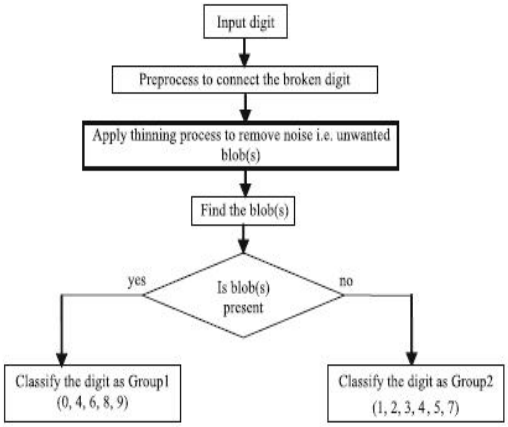


Fig.11. Decision tree for English numerals

F. Enhancement of images

Image enhancement is the technique which is based on interpretability or perception of information in images for human viewers and providing `better' input for other automated image processing techniques [3].

Image enhancement simply means, transforming an image *f* into image *g* using *T. (Where T* is the transformation. The values of pixels in images *f* and *g* are denoted by *r* and *s*, respectively.

$$s = T(r) \quad \ldots\ldots(2)$$

where *T* is a transformation that maps a pixel value *r* into a pixel value *s*.



Fig.12 Original image [3]



Fig.13. Enhanced image

Because of lower contrast and higher noise than the daytime images, nighttime images taken from the surveillance cameras are difficult to understand. So improvement of nighttime images is an important issue [4]. Denighting method enhances nighttime images so that they are closer in quality to images taken during the daytime

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(a) Night time image [4]



(b) Denighted image [4]

Fig.14.. Image enhancement

G. Filtering for Noise Reduction

Filtering process can be done by linear and non-linear filtering method. Gaussian filter and mean filter is the example of linear filter and Median filter is the example of non-linear filter. Noise can be added in images through the camera. Different types of noise are- amplifier noise, salt-and-pepper noise, shot noise, speckle noise [7].

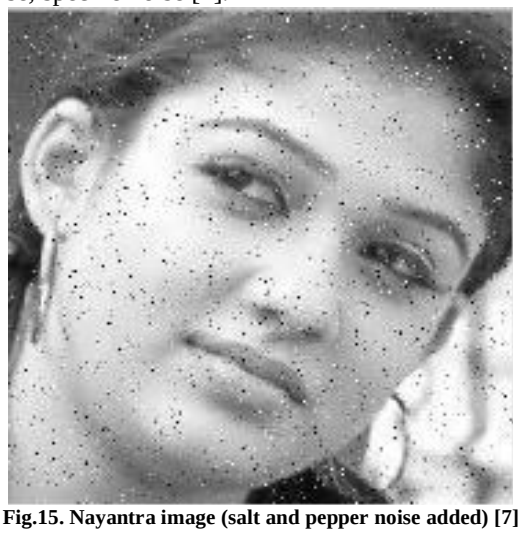


Fig.15. Nayantra image (salt and pepper noise added) [7]



Fig.16. De-noising by using median filter

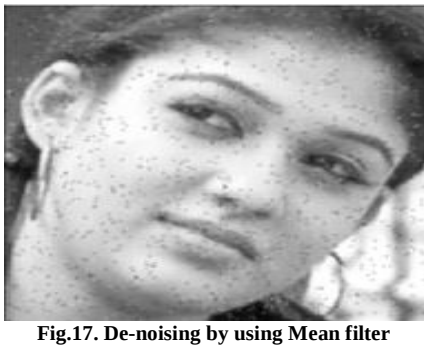


Fig.17. De-noising by using Mean filter

CONCLUSIONS

It has been concluded that image processing has many applications in today's world. So, image processing is helpful for the areas where image is an input.

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