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A Survey on Image Processing Techniques: Applications, Advantages, Challenges Overview

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ABSTRACT

In recent days, computation capability of the advanced CPU processor enhances distinct real-time applications which are made possible and implemented in distinct fields such as academic, industry, and research communities. In addition, one of the major real-time techniques in recent day is image processing (IP). Image processing is a rapidly growing field in which researchers are working indefinitely for maximizing the reliability and reproducibility of images at different levels. On the other side, IP forms a core research area through which it can be helpful in diverse sectors including medical, road safety, remote sensing and so on. Further, this survey of research work focuses on image processing techniques, applications such as medical, remote sensing fields, object detection along with advantages and challenges in real time. Ultimately, this research ensures recommendation for future research direction in the field of image processing.

KEYWORDS: Image processing, object detection, remote sensing field, medical, Transport

1. INTRODUCTION

Image processing is a method to perform various operations on a picture to get an enhanced image or to extract some useful information from the original image. In other words, IP is a kind of signal processing in which input is an image and output may be an image or characteristics/features associated with that particular image. In general, image is represented in terms of dimensions (height and width) based on the number of pixels. For instance, if the dimensions of an image are 500 x 400 (width x height), the total number of pixels within the image is 200000. The pixel is a point on the image that takes on a specific shade, opacity or colour. It is usually represented in the following categories that are mentioned below,

Grayscale - A pixel is an integer with a value between 0 to 255 (0 is totally black and 255 is denoted as white).

RGB - A pixel is made up of 3 integers that lies in 0 to 255 (the integers represent the intensity of red, green and blue). 4 shares information about the flexible YAML templating system created for it, its advantages and disadvantages. Section 5tells us about the methodology and the process description. Section 6 tells us about the future scope and concludes the paper with acknowledgement and references.

RGBA – It is an extension of RGB with a new alpha field which represents the opacity of the image.

Also, image processing system usually treats every image as 2D signals by applying certain predetermined signal processing methods. In addition, Image processing

technique differentiates from moving object with a help of various efficient algorithm. Further to detect the object in two main techniques this can be entitled below,

Edge Detection - Used to enhance the image frames

Morphological Processing – Mainly used to remove noise as well as adjust the image respectively. Moreover, many research works can be done in the form of simulation-based research through MATLAB Software [1].

2. IMAGE PROCESSING TECHNIQUES

Despite, many considerable technologies can be used to implement the concept of image processing. Consequently, the survey reveals some of the latest image processing techniques in detailed,

1. Morphological process:

i.) **Binarization:**

The binarization process involves the conversion of a grayscale image into a binary image. Here, binary images are termed as bi-level or two-level this means that each pixel is accumulated as a bit (0 and 1). Pixel value is set by using threshold value which is explained in further section [2].

In more specific manner the thresholding methods restore every pixel in picture with a black pixel then the image intensity Iij is smaller amount than some fixed constant T is shown in equation 1.

$$I_{ij} < T \text{ ---------- } (1)$$

For white pixel, if the image intensity is bigger than constant value which is displayed in the equation 2.

$$I_{ij} > T \text{ [2] ---------- } (2)$$

ii.) **Edge detection**:

For edge detection, the canny edge detection technique is applied to resultant frames. Alternatively, smoothened image is then filtered with a sobel kernel in both horizontal and vertical direction to get the primary derivatives. Horizontal direction is denoted as (Gx) and vertical direction as (Gy). From these two images corresponding equation 3 is generated:

Find edge gradient and direction for each and every pixel as follows:

Edge Gradient (G)=G2x+G2y

Sqrt (Angle (theta)) =tan−1 (GyGx) ------- (3)

iii.) **Masking Operation**:

Masking operation is an iterative process of putting the mask on the visualized objects of the binary image. The binary image shows its content as 0 and 1 (0 is for black and 1 is for white). The white partition of the image is the objects present on the image in highways. In this step superimposing of the mask on the white partition of the image is carried out if the mask fits the white partition, it is simply detected and counts the vehicle and draws a box around the detected vehicle else ignore the object then considering it as non-vehicle object. Finally, the masking image is superimposed on the original/first image.[2]

2. Blob Analysis:

Blob analysis identifies potential objects and insert box around them. Generally, it finds the area of the blob from the rectangular fit around each blob, the centroid of the object can be extracted for tracking the object. The additional rule is that the area of the blob to the area of the rectangle around a blob should be greater than 0.4 which ensures that unnecessary objects are not detected [3]. The blob analysis for feature detection can detect the shadow underneath the vehicles with improved accuracy and low computational time [4].

3. Labelling Area

Connected component labelling is employed to eliminate noises that interfere with the detection like the road sign, trees, road marks and other interfering elements which will disrupt the accuracy of car detection. The connected component of the image information is required from the image connected neighbors. Each component within the image parameter of its pixel area and orientation is employed. The conditions applied on all components present within the binary image with the orientation are determined by the angle of the road markings that interfere with the vehicle shadows. Hence the pixel area is to get rid of small noises and huge objects with a condition are employed periodically [4].

4. Background subtraction:

Mainly, background subtraction is the core idea for several object detection algorithms. With relevance to the normal background subtraction fixed image is termed as background image. Every frame of the video is then subtracted from this background image and the resulting image is then subjected to the thresholding process to get the final output as a logical (binary) image [5].

i. Adaptive background subtraction:

Mostly, adaptive background subtraction is similar to the native background subtraction method except for the fact that background image keeps updating by its own exactly in case of several image changes [5].

5. Shadow removal:

Previously, adaptive background subtraction handles any illumination modification. Also users need to remove the shadows to avoid false detections using the following properties of a shadow as follows,

1. Shadow regions are usually darker.
2. Shadows represent the same background pixel under darker illumination.
3. They share the same background texture pattern [5].

3. INDUSTRIAL USES OF IMAGE PROCESSING

1. Medical field:

There are plenty of applications within the medical field that features a domain in digital image processing. In medical image processing, it extracts the detailed image of the human body from the Computed Tomography (TC) or Magnetic Resonance Imaging (MRI) scanner.

Gamma-ray imaging, PET scan, X-Ray imaging, Medical CT scan, and UV imaging are some medical image processing applications.

2. Patten Recognition:

Pattern Recognition is the process of recognizing patterns using image processing techniques together with efficient machine learning algorithm. However, pattern recognition is defined as the classification of data based on the knowledge that has already been gained.

3. Remote Sensing Field:

Another application of digital image processing is to detect infrastructural damages caused by an earthquake. The key steps with the analysis include the extraction of edges and analysis and enhancement of various types of edges. Therefore, the area affected by the earthquake is so wide that it is not possible to examine the damage with the naked eye. Further, it will be a very complicated and time-consuming procedure. In this situation, the image processing technique is employed to capture an image from above the ground level and then helps in analysing the damage and further actions being taken frequently.

4. Hurdle Detection

Hurdle detection is one of the simple tasks which can be done through image processing by detecting the different objects in the image and then approximately calculating the distance between the model and objects. It can be done by using the camera with some information about image processing.

5. Vehicle Detection:

Mostly, object detection is well-known research and a lot of algorithms are proposed on the same. In other side, vehicle detection in real-time video is a challenging task hence any false detection can result in a false alarm.

6. Computer Vision:

It is used to make examine the computer can identify and process many different things. The important role of computer vision is in automatic driving cars, drones which identifies the object which is moving or placed in front of it and react accordingly

4. ADVANTAGES OF IMAGE PROCESSING

- Digital image processing made the digital image can be noise-free [6].
- It can be made available in any desired format (X-Ray, photo negativity, improved image, etc).
- It can be used to extract maximum information from digital images.
- Images can be stored in the computer memory and easily retrieved on the same computer screen.
- Image processing is also used to extract useful features which are further used in several AI applications.

5. CHALLENGES ON IMAGE PROCESSING

- In general, performing complex image processing high hardware capability is required.
- To process on video frames then it includes a lot of security issues (watermarking, Encryption and stenography) [10].
- Scale variation - which means having the image of same object with multiple size.[1]
- Once the model gets damaged the image will be lost.
- More number of training data is required to train the model for getting more accuracy.

6. FUTURE SCOPE AND CONCLUSION

Image Processing has significantly improved the way we lived, in almost all possible ways. It is tough to imagine a sector without the influence of this domain. The future world is going to be filled with Digital Image Processing working in all possible areas in a combined effort with humans. The successful implementation can

revolutionize the entire world by reducing the manual efforts of people.

This paper briefly explains the techniques in image processing like a morphological process which has subcategories like edge detection binarization, marking operation etc, various applications in the medical field, remote sensing field and image processing is also used in object detection, patten recognition and computer vision technology. Various software like MATLAB, PYCHARM etc can be used. The advantages and challenges on digital image processing have also been discussed in this paper. This image processing is very useful and beneficial when implemented in required industries.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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