Data Analytics and Artificial Intelligence
Vol: 3(7), 2023
REST Publisher; ISBN: 978-81-948459-4-2
Website: http://restpublisher.com/book-series/daai/

An Investigation on Digital Image Processing and Applications

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Abstract: *The field of digital image processing has experienced continuous and significant expansion in recent years. The usefulness of this technology is apparent in many different disciplines covering medicine through remote sensing. The advances and wide availability of image processing hardware has further enhanced the usefulness of image processing. In imaging science, image processing is any form of signal processing for which the input is an image, such as a photograph or video frame and the output may be either an image or a set of characteristics related to the image.*
Keywords: *Steps in Digital Image Processing, Image Processing Techniques, Applications of Image Processing.*

1. INTRODUCTION

Image processing basically follow these procedure. First we import an image with optical scanner or by digital photography the next step is analyzing the image which includes data compression and image enhancement. Final step is out come, it is the last stage in which result can be altered image or report that is based on image analysis. Image processing is closely related to computer graphics and computer vision. In computer graphics, images are manually made from physical models of objects, environments, and lighting. Computer vision, on the other hand, is often considered as high-level image processing out of which a machine or computer intends to decipher the physical contents of an image. The types of methods used for Image Processing are Analog and Digital Image Processing. Analog or visual techniques of image processing can be used for the hard copies like printouts and photographs. Digital Processing techniques help in manipulation of the digital images by using computers. As raw data from imaging sensors from satellite platform contain deficiencies. The helpfulness of this knowledge is superficial in numerous dissimilar chastisements covering in various applications.

2. STEPS IN DIGITAL IMAGE PROCESSING

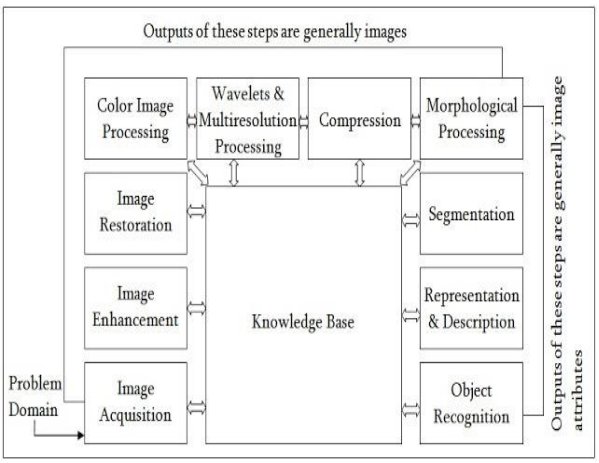

FIGURE1. Steps In Digital Image Processing

Image acquisition as being given an image that is already in digital form. Generally, this stage involves pre-processing, such as scaling etc. Image enhancement, the idea behind this techniques is to bring out detail that is obscured, or simply to highlight certain features of interest in an image. Such as, changing brightness & contrast etc. Image restoration deals with improving the appearance of an image. It is based on mathematical or probabilistic models of image degradation. Color image processing has been gaining its importance because of the significant increase in the use of digital images over the Internet. This may include color modelling and processing in a digital domain etc. Wavelets & Multi resolution processing, Wavelets acts as the foundation for representing images in various degrees of resolution. Compression deals with the techniques for reducing the storage required to save an image or the bandwidth to transmit it. Morphological processing deals with tools for extracting image components that are useful in the representation and description of shape. Segmentation procedures partition an image into its constituent parts or objects. The level to which this subdivision is carried out depends on the problem being solved. Segmentation techniques are used to isolate the desired object from the scene so that measurements can be made on it subsequently. Representation & description always follow the output of a segmentation stage, which usually is raw pixel data, constituting either the boundary of a region or all the points in the region itself. Object recognition, Recognition is the process that assigns a label, to an object based on its descriptors. Knowledge base, It can be quite complex, such as an interrelated list of all major possible defects in an image database containing high-resolution satellite images of a region in connection with change-detection applications.

3. IMAGE PROCESSING TECHNIQUES

Image processing techniques are task specific and vary according to the problem. The following are the well-known techniques used in different applications:

3.1Image representation: An image defined in the "real world" is considered to be a function of two real variables, for example, $f(x,y)$ with f as the amplitude (e.g. brightness) of the image at the *real* coordinate position (x,y).

3.2Image Pre-processing: The theme of the technique of magnifications to have a closer view by magnifying or zooming the interested part in the imagery. By reduction, we can bring the unmanageable size of data to a manageable limit.Magnificationis usually done to improve the scale of display for visual interpretation or sometimes to match the scale of one image to another.

3.3Image Analysis: *Image analysis* is concerned with making quantitative measurements from an image to produce a description of the image. It require extraction of certain features that aid in the identification of the object.

3.4Image restoration: *Image restoration* refers to removal or minimization of degradations in an image. This includes de-blurring of images degraded by the limitations of a sensor or its environment, noise filtering, and correction of geometric distortion or non-linearity due to sensors. Image is restored to its original quality by inverting the physical degradation phenomenon such as defocus, linear motion, atmospheric degradation and additive noise.

3.5Morphological Image Processing: The morphological operators are used to remove noise and find out their edges. The following Morphological operators are used to process natural scene images for detection of text.

3.6Dilation: It is a process performed by laying the structuring element B on the image A and sliding it across the image in a manner similar to convolution. If the origin of the structuring element coincides with a 'white' pixel in the image, there is no change; move to the next pixel. If the origin of the structuring element coincides with a 'black' in the image, make black all pixels from the image covered by the structuring element.

3.7Erosion: Erosion is performed in similar manner as in the case of dilation i.e. it is performed by laying the structuring element B on the image A and sliding it across the image in a manner if the origin of the structuring element coincides with a 'white' pixel in the image, there is no change, move to the next pixel. If the origin of the structuring element coincides with a 'black' pixel in the image, and at least one of the 'black' pixels in the structuring element falls over a white pixel in the image, then change the 'black' pixel in the image from ‘black’ to a 'white'.

3.8Opening*:* It consists of an erosion followed by a dilation and can be used to eliminate all pixels in regions that are too small to contain the structuring element.

3.9Closing: It consists of a dilation followed by erosion.

3.10Edge detection technique:

Edge can be defined as discontinuities in image intensity from one pixel to another. It can be used to predict the shape and size of the objects. Edge detection helps detection of text. The following are few edge detection techniques.

3.11Sobel operator: Sobel edge detection is used to detect edges along the horizontal and vertical axis. The operator is based on convolving the image using kernel.
3.12Homogeneity Operator*:* Homogeneity operator uses subtraction to find an edge in the image. The central pixel is replaced by the maximum result of these subtractions. The operator subtracts each of the pixels next to the center of a 3x3 area from the center pixel. Subtraction in a homogeneous region produces zeroand indicates an absence of edges.
3.13Difference Operator: The difference operator for edge detection is based on difference intensity values of corners of 3 x 3 convocation mask. In this method, we compute difference of intensity of mask at Upper left - Lower right ,Upper Right - Lower Left, Top –Bottom, Left – Right then we replace the center pixel with the maximum of these four values in the mask.
3.14The Canny Edge Detector: The Canny operator works in a multi-stage process. The image is smoothed by Gaussian convolution. After smoothing the image and Sobel operator performs to find out spatial gradient measurement. The Sobel operator uses a pair of 3x3convolution masks, one estimating the gradient in thex-direction and the other estimating the gradient in they-direction. Once the edge direction is known, the next step is to relate the edge direction to a direction that can be traced in an image after the edge directions are known, non-maximum suppression now has to be applied. Finally, hysteresis is used as a means of eliminating streaking.

4. APPLICATIONS OF IMAGE PROCESSING

4.1. Intelligent Transportation Systems: This technique can be used in Automatic number plate recognition and Traffic sign recognition.
4.2. Remote Sensing: For this application, sensors capture the pictures of the earth's surface in remote sensing satellites or multi – spectral scanner which is mounted on an aircraft. These pictures are processed by transmitting it to the Earth station. Techniques used to interpret the objects and regions are used in flood control, city planning, resource mobilization, agricultural production monitoring, etc.
4.3. Moving object tracking: This application enables to measure motion parameters and acquire visual record of the moving object. The different types of approach to track an object are: Motion based tracking, Recognition based tracking
4.4. Defence surveillance: Aerial surveillance methods are used to continuously keep an eye on the land and oceans. This application is also used to locate the types and formation of naval vessels of the ocean surface. The important duty is to divide the various objects present in the water body part of the image. The different parameters such as length, breadth, area, perimeter, compactness are set up to classify each of divided objects. It is important to recognize the distribution of these objects in different directions that are east, west, north, south, northeast, northwest, southeast and south west to explain all possible formations of the vessels. We can interpret the entire oceanic scenario from the spatial distribution of these objects.
4.5. Biomedical Imaging techniques*:* For medical diagnosis, different types of imaging tools such as X- ray, Ultrasound, computer aided tomography (CT) etc are used. The diagrams of X- ray, MRI, and computer aided tomography (CT) are given below.

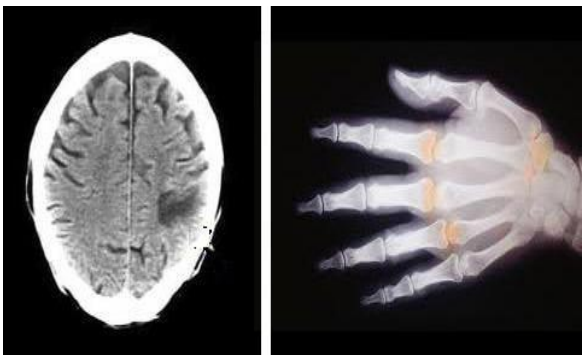

FIGURE2. *Biomedical Imaging techniques*

Some of the applications of Biomedical imaging applications are as follows:
· Heart disease identification– The important diagnostic features such as size of the heart and its shape are required to know in order to classify the heart diseases. To improve the diagnosis of heart diseases, image analysis techniques are employed to radiographic images. ·Lung disease identification – In X- rays, the regions that appear dark contain air while region that appears lighter are solid tissues. Bones are more radio opaque than tissues. The

ribs, the heart, thoracic spine, and the diaphragm that separates the chest cavity from the abdominal cavity are clearly seen on the X-ray film. Digital mammograms – This is used to detect the breast tumour. Mammograms can be analyzed using Image processing techniques such as segmentation, shape analysis, contrast enhancement, feature extraction, etc.

4.6Automatic Visual Inspection System: This application improves the quality and productivity of the product in the industries. Automatic inspection of incandescent lamp filaments – This involves examination of the bulb manufacturing process. Due to no uniformity in the pitch of the wiring in the lamp, the filament of the bulb gets fused within a short duration. In this application, a binary image slice of the filament is created from which the silhouette of the filament is fabricated. Silhouettes are analyzed to recognize the non-uniformity in the pitch of the wiring in the lamp. This system is being used by the General Electric Corporation. Automatic surface inspection systems – In metal industries it is essential to detect the flaws on the surfaces. For instance, it is essential to detect any kind of aberration on the rolled metal surface in the hot or cold rolling mills in a steel plant. Image processing techniques such as texture identification, edge detection, fractal analysis etc are used for the detection. Faulty component identification – This application identifies the faulty components in electronic or electromechanical systems. Higher amount of thermal energy is generated by these faulty components. The Infra-red images are produced from the distribution of thermal energies in the assembly. The faulty components can be identified by analyzing the Infra-red images.

5. CURRENT RESEARCH

Wide research is being done in the Image processing technique.

***5.1Cancer Imaging*:** Different tools such as PET, MRI, and Computer aided Detection helps to diagnose and be aware of the tumour.

***5.2Brain Imaging*:** Focuses on the normal and abnormal development of brain, brain ageing and common disease states.

5.3Image processing: This research incorporates structural and functional MRI in neurology, analysis of bone shape and structure, development of functional imaging tools in oncology, and PET image processing software development.

***5.4Imaging Technology*: Development** in image technology have formed the requirement to establish whether new technologies are effective and cost beneficial. This technology works under the following areas: Magnetic resonance imaging of the knee, Computer aided detection in mammography

6. FUTURE

We all are in midst of revolution ignited by fast development in computer technology as well as imaging Therefore the application development is very needed for this current world for various aspects. More research towards this topic is needed for future.

7. CONCLUSION

In this paper we have briefly reviewed various techniques of image processing and applications in image processing and , emerging current research in image processing and features of image processing applications. This will help researchers to know about the applications and futures of image processing.

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