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Digital Image Processing Real Time Applications

S.Padmappriya[1], K.Sumalatha[2]
[1](mphil computer science, kamban arts and science college for women, tiruvannamalai,TN India)
[2](Asst.professor and head, computer science, kamban arts and science college for women, tiruvannamalai,TN India)

Abstract: *Digital image processing has become economical in many fields like signature recognition, iris recognition and face recognition, in forensics, in automobile detection and in military applications. Each of these applications has its basic requirements, which may be unique from the others. Everyone is concerned and demands a system as faster, more accurate, cheaper and more extensive computation. This paper has reviewed various image processing operations to illustrate the basic concepts and to use them in different fields with minor changes in the methodology. This paper discusses about the basic technical aspects of digital image processing with reference to be categorized into three groups as: Image Rectification and Restoration, Enhancement and Information Extraction. Importance of digital image processing and its applications are also discussed from the fields of computer vision and other applications. An image is defined as an array, or a matrix, of square pixels arranged in rows and columns. Image processing is a procedure of converting an image into digital form and carry out some operation on it, in order to get an improved image and to retrieve some important information from the image.*

Keywords: *Biomedical imaging, digital image processing, face recognition, image enhancement, signature recognition.*

I. Introduction

Digital image processing deals with manipulation of digital images through a digital computer. Image processing is the application of signal processing techniques to the domain of Images — two-dimensional signals such as photographs or video. Image processing does typically involve filtering or enhancing an image using various types of functions in addition to other techniques to extract information from the images. The most common example is Adobe Photoshop. It is one of the widely used application for processing digital images. It also means "Analyzing and manipulating images with a computer ". Image processing is performed this three steps:

First, import images with an optical devices like a scanner or a camera or directly through digital processing .Second, manipulate or analyze the images in some way. This step can include image improvement and data summary, or the images are analyzed to find rules that aren't seen by the human eyes. For example, meteorologists use this processing to analyze satellite photographs. Last, output the result of image processing. The result might be the image changed by some way or it might be a report based on analysis or result of the images.

In the Fig.1 an image has been captured by a camera and has been sent to a digital system to remove all the other details, and just focus on the water drop by zooming it in such a way that the quality of the image remains the same.

Digital image processing is a very popular and rapidly growing area of application under computer science engineering. Its growth leads by technological innovations in the fields of digital imaging, computer processing and mass storage devices. Fields which have been traditionally using analog imaging are now switching to digital systems, for their edibility and affordability. Important examples are medicine, and video production, photography, remote sensing, and security monitoring. These sources produce a very huge volume of digital image data daily, more than could ever be examined manually. Basically image processing can be defined as the processing of a two dimensional picture by a computer. The outcome of image processing could be an image or a result as set of features or characteristics related to the image. Most image processing methods treats an image as a two dimensional signal and implementing standard signal processing techniques to it.

Some of the important applications of image processing in the field of science and technology include computer vision, remote sensing, feature extraction, face detection, forecasting, optical character recognition, finger-print detection, optical sorting, argument reality, microscope imaging, lane departure caution system, Non-photorealistic representation, medical image processing, and morphological imaging.

II. Headings

1) Computer Vision - Computer vision is a kind of automated watchdog, which uses both science and technology. Being a discipline from science, computer vision is related to theory for design of artificial systems that can acquire information from images. The image input may be of many formats, such as a video signal sequence, or multiple views from different cameras, or data input from a medical scanning machine. Examples of applications of computer vision include systems for controlling processes such as an industrial robot or an autonomous vehicle; for detecting events such as in visual surveillance or people counting; for organizing information such as for indexing databases of images and image sequences; for modeling objects or environments such as industrial inspection, medical image analysis or topographicalmodeling; for interaction such as the input to a device for interaction between a computing machine and human.

2) Face Detection - In this method important facial features are detected and else are ignored. Face detection can be treated as a specific case of object class detection. The objective of face detection is to find the specified features such locations and sizes of a known number of faces. Various face detection algorithms are focused on the detection of frontal human faces. It is also an attempt to solve the more general and difficult problems of multi view face detection.

3) Digital Video Processing - In different engineering and computing applications video processing is a particular and an important case of signal processing. Here the input and output signals are video files or video streams. Video processing techniques are used in television sets, VCRs, DVDs, video codec, video players and other devices. For example commonly only design of various systems and video processing methodology is different in TV sets by different companies.

4) Remote Sensing - Remote sensing is basically an acquisition of small or large scale information signals from an object or phenomenon, by the using various real-time sensing devices that are wireless in nature, or not in physical or direct contact with the object (such as aircraft, spacecraft, satellite or ship). Practically remote sensing is a collection of different data signals using variety of devices for gathering information on a given object or area. The monitoring of a parolee using an ultrasound identification system, Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET), X-radiation (X-ray) and space probes are all examples of remote sensing.

5) Biomedical Image Enhancement & Analysis - Biomedical image enhancement is very important issue for biomedical image diagnosis, the aim of this area is to enhance the biomedical images. In addition to originally digital methods, such as Computed Tomography (CT) or Magnetic Resonance Imaging (MRI), initially analog imaging modalities such as traditional applications like endoscopy or radiography are nowadays equipped with digital sensors. Digital images are composed by individual pixels to which points to discrete brightness or different color values. After biomedical image enhancement & proper analysis, they can be efficiently processed & objectively evaluated.

6) Biometric Verification - It refers to the automatic identification or recognition of humans by their behaviors or characteristics. Biometrics recognition is such an efficient type of identification and access control. It can also be used to recognize individuals in groups that are under observation. The purpose of such a technique is to ensure that the rendered services are accessed only by a legitimate user and no one else. A biometric system is theoretically a pattern recognition system that is based on acquiring biometric data from an individual. The operating principle is based on extracting set of defined features from the acquired data, and comparing this feature set against the template set in the database. Depending on the type and mode of application, a biometric system may work under verification mode or identification mode.

7) Signature Recognition - Signature verification and recognition is also an important application, which is to decide, whether a signature belongs to a given signer based on the image of signature and a few sample images of the original signatures of the signer. Handwritten signatures are imprecise in nature as their corners are not always sharp, lines are not perfectly straight, and curves are not necessarily smooth. Furthermore, the fonts can be drawn in different sizes and orientation in contrast to handwriting which is often assumed to be written on a baseline in an upright position. Therefore, a robust handwritten signature recognition system has to account for all of these factors.

8) Underwater Image Restoration & Enhancement - In Underwater Image processing, the basic physics of light propagation in the water medium comes into extinction. When the light enters into water, it exponentially attenuates with the depth of water level; therefore the visibility distance is affected and so limited. Underwater images suffer from different problems such as blurring, non uniform lightening, noise, low contrast, etc. Therefore, restoration & enhancement of underwater images is an essential area for research. Various filters are used in the enhancement methods to improve the image quality, to suppress the noise, to preserve the edges in an image and for smoothening of the image.

9) Character Recognition - Character recognition, usually known as optical character recognition or abbreviated as OCR. It is mechanical or electronic translation of images of either handwritten or printed text

(usually captured by a scanner) into machine editable text. It is a wide area for researchers in pattern recognition, artificial intelligence and machine vision. For many document input tasks, character recognition is the most cost effective and speedy method available.

10) Medical Palmistry - Palmistry is a science which observes human palm by different aspects and derives conclusions about nature of the person. Since from ancient times, many civilizations like Indian, Chinese, Persian, Egyptian, Roman and Greek, people were used to get guidance about their present and future by means of palmistry. It includes attributes of human, like, health, psychology, intelligence, lifestyle and other related entities. Medical palmistry can be considered as one of the branches of palmistry. By using this medical palmistry, probable diseases can be identified by observing some symbols in human palms such as Iceland, cross, grill, spot, star, square and circle. Additionally shapes of palm and fingers also play very important role in such decision making for identification of diseases.

III. Methodology

The process of analysis using digital image processing can be divided into various phases. The blocks diagram of a digital image processing (DIP) system is shown in Fig 2. The general functioning of different block stages are briefly discussed as followings:

1. Image Acquisition: It is the first step or fundamental step of digital image processing. Under image acquisition the image is given in digital format. Generally, this stage of image acquisition stage involves preprocessing, such as scaling etc. An image can be made input by some sort of scanner, digital cameras or with the help of aerial cameras .This image should be a high quality image with greater resolution, which helps in proper image analysis.

2. Preprocessing - Some preprocessing operations are required to be performed on the input image. The aim of preprocessing techniques is to improve the image data to suppress the unwanted distortions and to enhance some features of the input image. When processing high resolution images, the image size is needed to be reduced because of the reason that processing on high resolution images takes a longer time. Then after the color image is converted into grey scale image, because less information is needed to be provided for each pixel. In fact grey color is the one in which the red, blue and green components contain equal intensities; therefore it is necessary to specify a single value of intensity level for each pixel.

3. Edge Detection & Segmentation - Under edge detection some points are required to be identified to capture some important changes and events in the properties of the image. In case of image segmentation, image is identified into multiple segments. In form of these segments an image that is more meaningful and easy to analyze. Segmentation is accomplished by scanning the image pixel by pixel and then after each pixel is labeled, depending on whether the grey level is greater or less than the threshold value.

4. Image Restoration: Image restoration is an area, in which the appearance of an image is improved. Image restoration techniques are based on mathematical models or probabilistic analysis of an image. There are various filter available or can be designed for the restoration and to enhance the quality of an image.

5. Output Image - After using various image processing techniques accompanied with morphological operation on digital image, the object of interest from the given image can be obtained.

IV. Figures and Tables

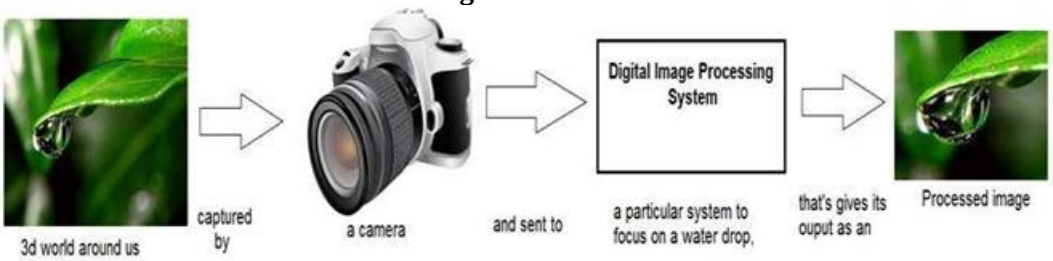

Fig. 1.how digital image processing works

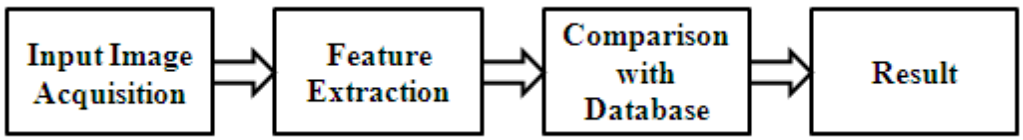

Fig 2 - Block Diagram of a DIP System

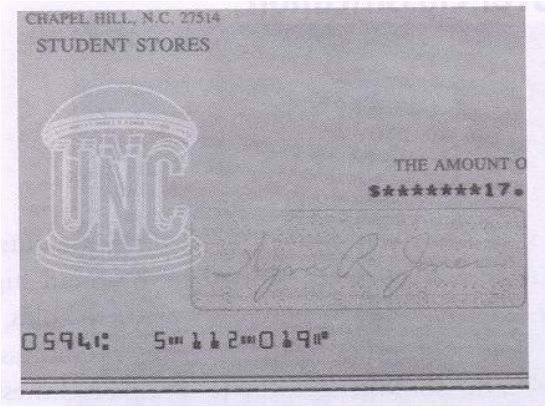

Fig 3 - Document Handling[12]

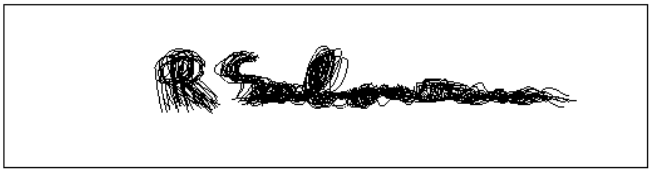

Fig 4 - Signature Verification[7]

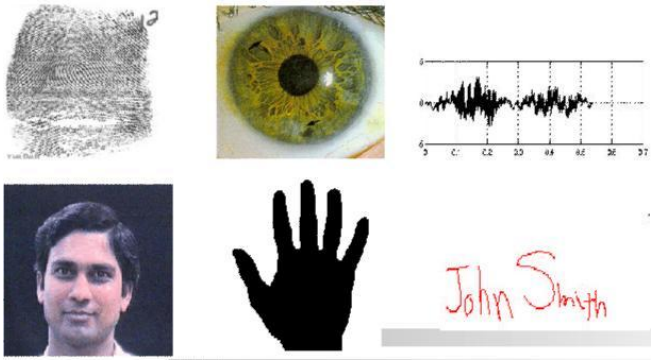

Fig 5 - Biometrics[14]

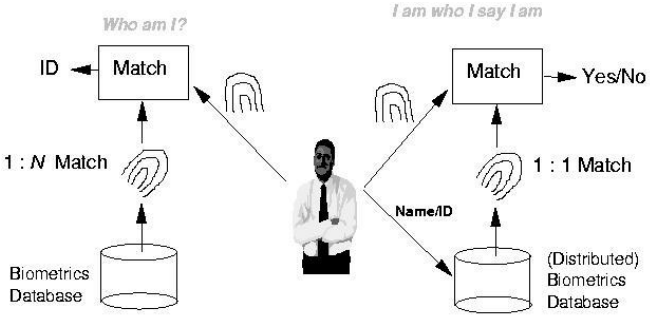

Fig 6 - Fingerprint Verification / Identification[9]

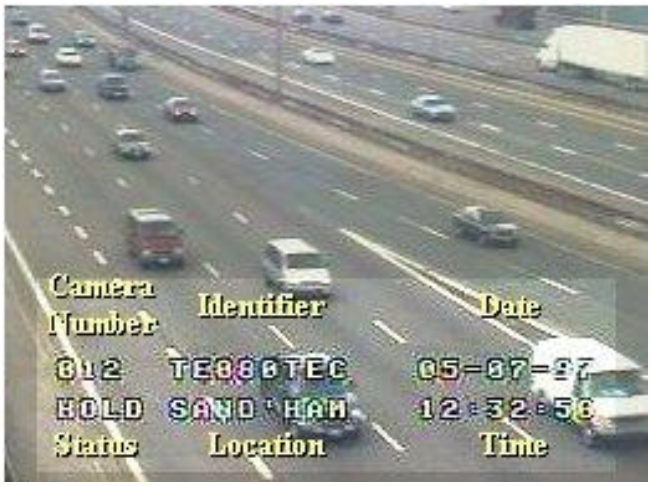

Fig 7 - Traffic Monitoring[4]

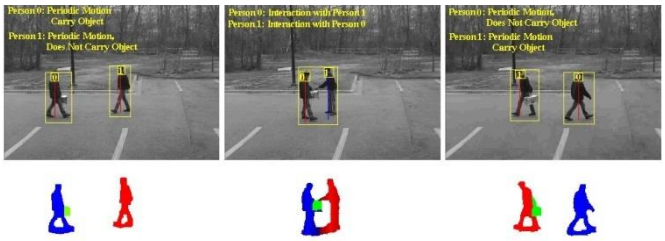

Fig 8 - Human Activity Recognition[2]

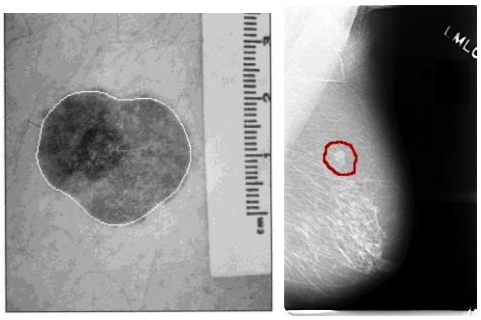

Fig 9 - Medical Applications-skin cancer[1]

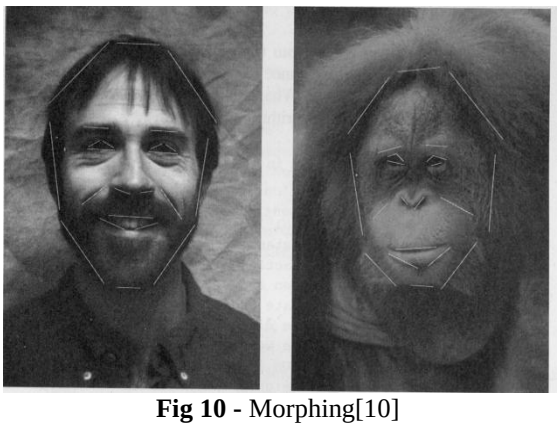

Fig 10 - Morphing[10]

V. Conclusion

The basics of image processing such as Image, image-analysis and understanding, image-transforms, compression techniques, optical character recognition (OCR) and its applications such as video and 3D graphics firmness, Remote Sensing, Pattern gratitude, Visual content analysis, Biometrics, Statistical image processing,

Multimedia interacting and Virtual reality, face detection and medical image processing are discussed in this paper. This study will help the researchers to work on various fields such as image processing, fault detection in industrialized Industries, medical image segmentation. The biggest limitation of all these algorithms is that the accuracy of these algorithms is dependent on the resolution quality of camera and view angle between camera and the target object. It is also observed that at some angles the results were not accurate beyond a certain range of camera.

The future of digital image processing involves new intelligent, digital automated robots created entirely by research scientists in various nations of the world. It includes advancements in various digital image processing applications. Due to innovations in image processing and other related technologies, there will be millions and millions of robots in the world in a few decades of time span, transforming the way the world is managed. Advance researches in image processing and artificial intelligence will involve voice commands, anticipating the information requirements of governments, translating languages, recognizing and tracking people and things, diagnosing medical conditions, performing operation & surgery, reprogramming defects in human DNA, and automatic driving all formats of transportation. With increase in power and sophistication of modern computing, the concept of computation can be extended beyond the present limits. In future, image processing technology will be more advanced and the visual system of man can be replicated. The future trends in remote sensing will be aiming towards various improved sensors that can record the same scene in many spectral channels. Graphics data is also getting tremendously importance in the field of digital image & signal processing app1ications.

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