FUNDAMENTALS OF IMAGE PROCESSING IN MATLAB

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Abstract: **Digital Image Processing refers to processing of the image in digital form. Modern cameras may directly take the image in digital form but generally images are originated in optical form. They are captured by video cameras and digitalized. The digitalization process includes sampling and quantization. Then these images are processed by the five fundamental processes, at least any one of them, not necessarily all of them.**

Index Terms: **MATLAB, Image Processing, Acquisition, Preprocessing, Segmentation, Representation, Recognition**

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I. INTRODUCTION

Digital Image Processing refers to processing of the image in digital form. In this series of four articles, fundamentals, as well as advanced topics of image processing using MATLAB, are discussed. The articles cover basic to advanced functions of MATLAB's image processing toolbox (IPT) and their effects on different images. The digitalization process includes sampling and quantization. Then these images are processed by the five fundamental processes, at least any one of them, not necessarily all of them.

Fundamentals steps in Image Processing

- Image acquisition
- Image pre processing
- Image segmentation
- Image description
- Image representation
- Image recognition
- Image interpretation

Image acquisition

Image acquisition in image processing can be broadly defined as the action of retrieving an image from some source, conventionally a hardware predicted source, so it can be passed through whatever processes need to occur afterward. Performing image acquisition in image processing is always the first step in the workflow sequence because, without an image, no processing is possible. The image that is acquired is plenarily unprocessed and is the result of whatever hardware was habituated to engender it, which can be very paramount in some fields to have a consistent baseline from which to work. One of the ultimate goals of this process is to have a source of input that operates within such controlled and quantified guidelines that the same image can, if indispensable, be proximately impeccably reproduced under the same conditions so anomalous factors are more facile to locate and eliminate.

Image pre processing

In imaging science, image processing is processing of images utilizing mathematical operations by utilizing any form of signal processing for which the input is an image, a series of images, or a video, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters cognate to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. This is the step taken before the major image processing task. The problem here is to perform some basic tasks in order to render the resulting image more suitable for the job to follow. In this case it may involve enhancing the contrast, removing noise, or identifying regions likely to contain the postcode.

Image segmentation

Segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.

Image description

Image description is the process of extract features that result in some quantitative information of interest or features that are basic for differentiating one class of objects from another.

Image representation

Image representation is the process of convert the input data to a form suitable for computer processing.

Image recognition

Image apperception is the process of identifying and detecting an object or a feature in a digital image or video. This concept is utilized in many applications like systems for factory automation, toll booth monitoring, and security surveillance. Typical image apperception algorithms include:
- Optical character apperception
- Pattern and gradient matching
- Face apperception
- License plate matching
- Scene change detection

Image interpretation

Image interpretation is the process of assign meaning to an ensemble of recognized objects. The features that our brains use when we interpret an image can be grouped into five main types, summarized.
- Tone: variations in relative effulgence or colour.
- Pattern: the arrangement of different tones and textures; may designate certain types of geology or land use.
- Shape: distinct patterns may be due to natural landforms or human shaping of the land.
- Size: apperception of familiar objects sanctions size estimation of other features; size is a paramount aspect of sodality: the context of features in an image.
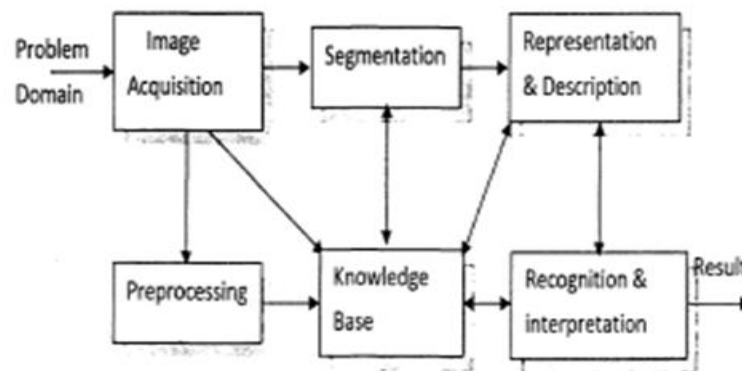
Block Diagram of Fundamental Sequence Involved in an Image Processing System

II. IMAGE PROCESSING GOAL

In virtually all image processing applications, however, the goal is to extract information from the image data. Obtaining the information desired may require filtering, transforming, coloring, interactive analysis, or any number of other methods. To be somewhat more specific, one can generalize most image processing tasks to be characterized by one of the following categories:

Image enhancement

Image enhancement techniques have been widely utilized in many applications of image processing where the subjective quality of images is consequential for human interpretation. Contrast is a paramount factor in any subjective evaluation of image quality. Contrast is engendered by the difference in luminance reflected from two adjacent surfaces. In other words, contrast is the difference in visual properties that makes an object distinguishable from other objects and the background. In visual perception, contrast is resolute by the difference in the colour and effulgence of the object with other objects. Our visual system is more sensitive to contrast than absolute luminance; consequently, we can perceive the world similarly regardless of the considerable transmutations in illumination conditions. This simply means improvement of the image being viewed to the (machine or human) interpreter's visual system. Image enhancement types of operations include contrast adjustment, noise suppression filtering, application of pseudo color, edge enhancement, and many others.

Image restoration

The purpose of image restoration is to "compensate for" or "undo" defects which degrade an image. Degradation comes in many forms such as motion blur, noise, and camera miscues. In cases like motion blur, it is possible to come up with a very good estimate of the actual blurring function and "undo" the blur to restore the original image. In cases where the image is corrupted by noise, the best we may hope to do is to compensate for the degradation it caused.

Image analysis

Image analysis is the extraction of meaningful information from images. Image analysis operations produce numerical or graphical information based on characteristics of the original image. They break into objects and then classify them. They depend on

the image statistics. Common operations are extraction and description of scene and image features, automated measurements, and object classification. Image analyze are mainly used in machine vision applications.

Feature extraction

Feature extraction involves simplifying the amount of resources required to describe a large set of data accurately. When performing analysis of complex data one of the major problems stems from the number of variables involved. Analysis with a large number of variables generally requires a large amount of memory and computation power or a classification algorithm which over fits the training sample and generalizes poorly to new samples. Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy. All the pre-processing techniques on image processing are implemented through MATLAB.

III. MAT LAB SPECIFICATION

MATLAB (matrix laboratory) is a numerical computing environment and fourth-generation programming language. Developed by Math Works, MATLAB sanctions matrix manipulations, plotting of functions and data, implementation of algorithms, engenderment of utilizer interfaces, and interfacing with programs indited in other languages, including C, C++, Java, and Fortran, The simplest way to execute MATLAB code is to indite it in the Command Window, which is one of the elements of the MATLAB Desktop. When code is entered in the Command Window, MATLAB can be utilized as an interactive mathematical shell. Sequences of commands can be preserved in a text file, typically utilizing the MATLAB Editor, as a script or encapsulated into a function, elongating the commands available. MATLAB provides a number of features for documenting and sharing your work. You can integrate your MATLAB code with other languages and applications, and distribute your MATLAB algorithms and applications.
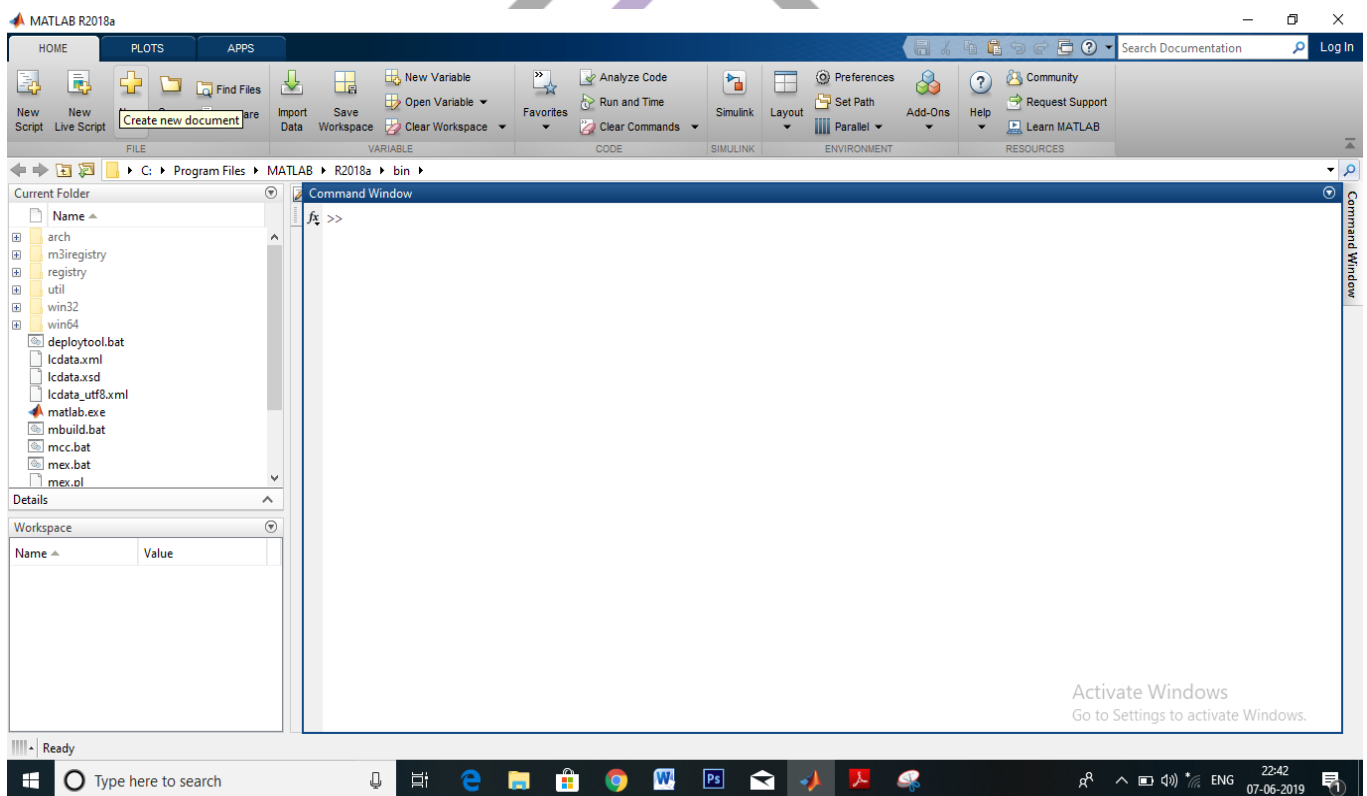
Matlab tool box

IV. FEATURES OF MAT LAB

• High-level language for technical computing.
• Development environment for managing code, files, and data.
• Interactive tools for iterative exploration, design, and problem solving.
• Mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, and numerical integration.
• Tools for building custom graphical user interfaces.

MATLAB is utilized in prodigious area, including signal and image processing, communications, control design, test and quantification, financial modeling and analysis, and computational. Integrate-on toolboxes (amassments of special-purport MATLAB functions) elongate the MATLAB environment to solve particular classes of quandaries in these application areas. MATLAB proves to be a profoundly efficient language for both communication and implementation.

V. CONCLUSION

The preferred spelling of the word "acknowledgment" in America is without an "e" after the "g". Avoid the stilted expression, "One of us (R. B. G.) thanks . . ." Instead, try "R. B. G. thanks". Put applicable sponsor acknowledgments here; DO NOT place them on the first page of your paper or as a footnote.

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