Chapter 10

A Study on Various Image Processing Techniques and Hardware Implementation Using Xilinx System Generator

Jyotsna Rani
National Institute of Technology Silchar, India

Abahan Sarkar
National Institute of Technology Silchar, India

Ram Kumar
National Institute of Technology Silchar, India

Fazal A. Talukdar
National Institute of Technology Silchar, India

ABSTRACT

This article reviews the various image processing techniques in MATLAB and also hardware implementation in FPGA using Xilinx system generator. Image processing can be termed as processing of images using mathematical operations by using various forms of signal processing techniques. The main aim of image processing is to extract important features from an image data and process it in a desired manner and to visually enhance or to statistically evaluate the desired aspect of the image. This article provides an insight into the various approaches of Digital Image processing techniques in Matlab. This article also provides an introduction to FPGA and also a step by step tutorial in handling Xilinx System Generator. The Xilinx System Generator tool is a new application in image processing and offers a friendly environment design for the processing. This tool support software simulation, but the most important is that can synthesize in FPGAs hardware, with the parallelism, robust and speed, this features are essentials in image processing. Implementation of these algorithms on a FPGA is having advantage of using large memory and embedded multipliers. Advances in FPGA technology with the development of sophisticated and efficient tools for modelling, simulation and synthesis have made FPGA a highly useful platform.

DOI: 10.4018/978-1-5225-1025-3.ch010
INTRODUCTION

Image is regarded as a relic that illustrates or records visual viewpoint. Considering an example of a two dimensional picture, we find that it has a similar appearance to some subject, or a physical object or a person, these all provide an illustration of the specified image. Images contain numerous objects and patterns. These patterns contain valuable information required for medicine, biology, photography areas or domains. In analyzing an image, inputs taken are images whereas outputs taken are either an image or a set of characteristics or parameters related to that of the image. The final motive of an image analysis is to acquire information from the gathered data through recognized or classified objects or classes or attributes and then take action accordingly to the acquired information.

BACKGROUNDS

Image is regarded as an artifact that depicts or records visual perception. Let us consider an example of a two dimensional picture, we find that it has a similar appearance to some subject, or a physical object or a person, these all provide a depiction of the specified image. Images contain plenty of objects and patterns. These patterns are actually attached with valuable information which are required for medicine, biology, photography areas or domains. In analyzing of an image, inputs taken are images whereas outputs taken are either an image or a set of characteristics or parameters related to that of the image. The final motive of an image analysis is to acquire information from the gathered data through recognized or classified objects or classes or attributes and then take action accordingly to the acquired information. For a digital image representation, an image may be represented as a two-dimensional function where x co-ordinate and y co-ordinate are spatial or planar co-ordinates, and the amplitude of the particular function at any pair of co-ordinates are regarded as the intensity of the image at that particular point.

A new descriptive name is introduced which is regarded as gray level which refers to the intensity of monochromatic images. In general, Color images are formed by a specified combinational mixture of individual images. For example, in the RGB color system, a color image is composed of three individual monochromatic images. They are denoted as the red (R), green (G) and blue (B) for primary images. An image may be continuous with respect to the spatial or planar co-ordinates. Its intensity may be continuous in terms of amplitude of the particular image. To convert such an image into a digitalized form we need to digitalize the co-ordinates, as well as the amplitude too. The process of getting the co-ordinate values digitalized are termed as sampling and the amplitude values is termed as quantization. Thus, when the spatial and planar co-ordinates along with the amplitude values of the particular two dimensional functions are all finite and discrete quantities, we regard the image as a digital image (Hasan et al., 2010). In general a digital image can be categorized into four groups or types. They are:

- **Gray Scale Image:** A gray scale image is a two dimensional matrix barcode which encodes the raw received information. Its values are represented as the shades of gray having integer values ranging from [0, 255] or [0, 65535] respectively.
- **Binary Images:** A binary image is a digital image. It has only two possible values allotted to each and every specified pixel. The two colors generally taken into consideration for a binary image are black and white. But it is not compulsory to choose the two fixed colors. Any two colors can be taken into consideration in order to represent a binary image. The color used for the targeted