



GAP 2 : an image processing package for UNIX
by Yuri Kalmykov

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in
Computer Science
Montana State University
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Abstract:

The project presented in this thesis is a UNIX/XWindows Motif-based image processing application. It implements a set of image processing and manipulation functions both in the spatial and frequency domains. The frequency domain transforms implemented are Fourier, Walsh and Wavelet transforms. The speed of those transforms is compared, the Walsh transform being the fastest. The Wavelet transform is one of the most recent developments in the image/signal processing. It is very effective in a wide variety of applications, including image coding/ compression, image segmentation and noise removal. Low and highpass filters are available for Fourier and Walsh transforms, and noise reduction filter is implemented for the Wavelet transform. A short theoretic overview is given for most of the implemented functions. The program works with the images in RAW format (256-level uncompressed grayscale images).

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APPROVAL

of a thesis submitted by

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This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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Date *May 19, 1997*

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ABSTRACT

The project presented in this thesis is a UNIX/XWindows Motif-based image processing application. It implements a set of image processing and manipulation functions both in the spatial and frequency domains. The frequency domain transforms implemented are Fourier, Walsh and Wavelet transforms. The speed of those transforms is compared, the Walsh transform being the fastest. The Wavelet transform is one of the most recent developments in the image/signal processing. It is very effective in a wide variety of applications, including image coding/ compression, image segmentation and noise removal. Low and highpass filters are available for Fourier and Walsh transforms, and noise reduction filter is implemented for the Wavelet transform. A short theoretic overview is given for most of the implemented functions. The program works with the images in RAW format (256-level uncompressed grayscale images).

CHAPTER 1

INTRODUCTION.

The aim of this project was the creation of an image processing application intended to work under the UNIX operating system, with the X Windows system. The described application (called GAP2) is written in C and employs the OSF/Motif user interface toolkit.

The goal was two-fold:

- a). To create a sophisticated, full scale Motif application and
- b). To research and implement a variety of image processing techniques.

GAP2 is the further improvement and development of the GAP ("Great Aerophoto Processor") IBM PC/MS Windows application developed in 1993. That version was very simple, it was capable of working on slow PC's (AT 286/386) that were most common in Russia at that time. Only the simplest image processing algorithms were implemented: masking, median filtering and several other local operations. Only spatial domain procedures were implemented (the procedure for Walsh transform was written and tested, but was not included in the final version of the program). Gap had no 'histogram-based' procedures either. The image was broken into small parts that were processed separately, because otherwise processing of the whole image at once took too much time (median smoothing took around 30 minutes for 512x512 image on an AT 486 DX/33). Processing was interactive: the user chose what operation to apply next. The overall goal was to obtain binary images

showing contours of artificial objects on Aerophoto (buildings, roads, etc.).

Since GAP2 was developed on a much more powerful computer system (DEC Alpha), it processes the whole image at once. Major improvements were made to the interface and spatial domain functions. Several new spatial domain functions were added. Plus, GAP2 contains 'histogram-based' operations and frequency domain operators based on three transforms: Fourier, Walsh and Wavelet.

GAP2 works with gray scale images stored in RAW format (up to 256 levels).

CHAPTER 2

PROJECT DESCRIPTION

User Interface and Related Features

The main window consists of the following areas shown in Figure 1:

- 1). Menu bar
- 2). Information panel
- 3). Toolbar
- 4). Image window
- 5). Lens
- 6). Histogram window.

The structure of Motif widgets that form the user interface of GAP2 is shown in Figure 2.

Menu Bar.

Menu bar contains the following items:

- 1). File.

It is a set of common file manipulation functions to be applied to image files:

- a). Load Image
- b). Save Image
- c). Delete Image.

All three functions invoke the standard Motif file selection dialog box. Also, this menu item contains the Quit option.

2). Tools.

A set of image manipulation tools:

- a). Flip image horizontally or vertically. Creates the mirror image relative to the horizontal or vertical image axes. These functions just reorder the rows (columns for vertical flip) of the image in reverse order.
- b). Rotation, 90 degrees clockwise or counter-clockwise. These functions transpose the image. In the clockwise case the first column of the initial image becomes the first row of the resulting image (and so on), in the counter-clockwise case the first row of the initial image becomes the first column of the new image..

3). Spatial.

A set of spatial domain image processing functions.

4). Walsh, Fourier, Wavelet.

Image processing functions in frequency domain. All image processing functions will be discussed in detail in Chapter 2.

5). Help. User help information (was not implemented).

Figure 1. GAP2 Main Window



