"I confess that I have read this report and for my opinion I think this report is sufficed in partial fulfillment of requirements for the Bachelor Degree of Electronic Engineering (Computer Engineering)."

Signature : 

Supervised by : MR. NURULFAJAR BIN ABD MANAP

Date : 5th May, 2006

IMPLEMENTATION OF IMAGE ENHANCEMENT ALGORITHM

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"I confess this report is all my own work except the certain passage that I have clarified each of their sources."

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ABSTRACT

This project is developing an implementation of image enhancement algorithm. By implementation of image enhancement algorithm, improved image could be obtained easily and instantly. Therefore image editing is not necessary. This project is applied on static image taken by a low cost camera. The image will be processed to produce an enhanced image. The enhanced image then is displayed at the computer. The main subject to this project is the image enhancement algorithm that is developed using programming language C++. From this algorithm, the complete system is combined using a low cost camera, C++ programming language and a personal computer. Upon the success this project will bring much benefit especially to the image industry and photography.

ABSTRAK

Projek ini bertujuan membina implementasi algoritma penambahbaikan imej. Dengan implementasi algoritma penambahbaikan imej, imej yang baik boleh diperolehi dengan mudah dan serta merta. Oleh itu, imej tidak perlu diedit semula. Projek ini menggunakan imej pegun yang diambil dari kamera kos rendah. Imej yang diambil tersebut diproses untuk menghasilkan imej yang lebih baik. Imej yang telah diproses itu kemudiannya dipaparkan di skrin komputer. Perkara utama di dalam projek ini ialah algoritma penambahbaikan imej yang dihasilkan menggunakan pengaturcaraan C++. Daripada algoritma ini, sistem yang lengkap akan dihasilkan menggunakan gabungan kamera kos rendah, pengaturcaraan C++ dan komputer persendirian. Kejayaan projek ini pasti akan memberi banyak faedah kepada industri pengimejan dan dalam bidang fotografi.

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LIST OF ABBREVIATION

PDA	–	Personal Digital Assistance
USB	–	Universal Serial Bus
RM	–	Malaysian Ringgit
MRI	–	Magnetic Resonance Imaging

CHAPTER I

INTRODUCTION

Chapter overview

In current technology digital image is widely used. We could see it through digital cameras, Personal Digital Assistance (PDA), hand phones and others. Digital image taken from these peripherals are sometimes low in quality. Therefore digital image enhancement is needed to improve the quality of the digital image. In this project, implementation of image enhancement algorithm is applied. This project enhanced the digital image taken by a camera. Then, the image is displayed at a computer and can be compared with the previous image.

1.1 Project objectives

1.1.1 To implement a real-time image enhancement algorithm

1.1.2 To learn and understand the image enhancement algorithm

1.1.3 To enhance and improve image quality taken from a camera

1.2 Scope of work

Scope of work in this project has been divided to several categories. It makes sure that the project would run smoothly without off target. It is also as guidance while proceeding with this project.

1.2.1 Hardware requirement

In this project, hardware that is going to be used is a camera. The camera is attached to the computer as to capture image and stored the image in the computer. The captured image is a digital image and is readied to be process. The camera specifications are monitor based, manual focus, Universal Serial Bus (USB) cable and still image capture is minimum 256 x 256 pixels. Another hardware used is a personal computer. Minimum system requirement for personal computer are Windows 98, 2000, Me or XP, Pentium III 450MHz or better, 128MB RAM, 500MB free hard drive space, CD-ROM drive, 16-bit color display adapter and available 1.1 or 2.0 USB port.

1.2.2 Image

Scope of image is the image used is a photography type of image. The image is in static form and colored image when it is taken. The image is also in digital image so it can be processes directly in the computer.

1.2.3 Implementation

In this project, implementation of the C++ programming is used. C++ programming is chosen because of the moderate performance that it could provide in enhancement process. Moreover it is a digital image that is suitable for processing in C++ programming environment.

1.2.4 Enhancement

The enhancement process that is going to be applied is the histogram equalization. Histogram equalization is the best way to analyze an image by using the histogram graph. From the histogram, an image condition could be known weather it is overexposed or underexposed. The image histogram then could be equalized in order to gain a better image.

1.2.5 Application

This project is intended to be used as a software development for camera or hand phone. Mostly it is suitable for any applications that involved with digital imaging. By using the software, image could be enhanced instantly without having to edit it in other software.

1.3 Problems statement

As this project is related to image, there are two main problems that are always occurred. First, a poorly exposed image. Image here is referred to photography that everyone always involved in. In general, not all who takes pictures is a professional

who knows how the lighting conditions are. For common people, take pictures mostly are resulting in poor exposed image because of poor lighting conditions. Plus with a camera that has low pixels rate, it did not give much help in obtaining good images.

Secondly is manual editing. Manually editing an exposed image is a way could be done to enhance the image. The poor exposed image could be sharpen and cleared using software like Adobe Photoshop. However it is time consuming and highly cost. It is time consuming because it has to spend time to edit the exposed image and highly cost because the software could cost hundreds of Malaysian Ringgit (RM), yet a computer must be own.

These problems could be solved by the proposed project, implementation of image enhancement algorithm. Therefore, this project will take place of the manually editing software image enhancement by the computer.

1.4 Thesis outline

Chapter 1 starts with introduction. In this chapter the objectives and scope of the project are stated. Here we could know the problem statements and the purposed of developing this project. Other than that the overall outline of thesis is also included as a guideline to understand the project.

Chapter 2 is about literature review of the project. In literature review will see the basic of image processing. How image processing is related to image enhancement and end up to digital histogram. Then, see the examples of fields that used digital image processing and the fundamental steps. Followed by methods that are used in image enhancement. It will also review on digital histogram and histogram equalization.

Chapter 3 will concentrate on project methodology. Project methodology will provide on how to implement image enhancement algorithm. A block diagram is used as guidance step by step. Each step is briefly explained with simple examples and pictures.

All the information in literature review, mostly on digital histogram is applied. The histogram and the equations are used to obtain the output.

Chapter 4 shows the results obtained by implementation of image enhancement algorithm. Several results are obtained from different kind of inputs, scenery, portrait and others. The results then are analyzed.

Chapter 5 concludes this thesis with discussions and suggestions that could improved the implementation of image enhancement algorithm.

Chapter conclusion

In this chapter the project overall operations and main events are determined and understood. The objectives of the project are clearly stated, the scope of work to make sure the project does not go off target and the problems statement are briefly explained. From this information, the project is developed to achieve the objectives.

CHAPTER II

LITERATURE REVIEW

Chapter overview

Chapter 2 is about literature review of the project. In literature review will see the basic of image processing. How image processing is related to image enhancement and end up to digital histogram. Then, see the examples of fields that used digital image processing and the fundamental steps. Followed by methods that are used in image enhancement. It will also review on digital histogram and histogram equalization.

2.1 IMAGE PROCESSING

Image processing is a process where a digital image that has been obtained, such as scanned image or image captured by cameras is being manipulated or changed in any term like size, contrast or brightness. The purposed of this digital image is being manipulated is maybe to improve and touch-up parts of the image. But image processing has more important application that is to compare and analyze images. So the characteristics that a human eye could not see from an image could be seen. From this application, image processing becomes vital in high-speed quality control, criminal forensics, medicine, defense, entertainment and the graphic arts.

2.1.1 Examples of fields that use digital image processing

Electromagnetic wave is a varying wavelength that could be categories according to energy per photon. Images could be divided to this electromagnetic spectrum in terms of the function of the image as in Figure 2.1. [2]

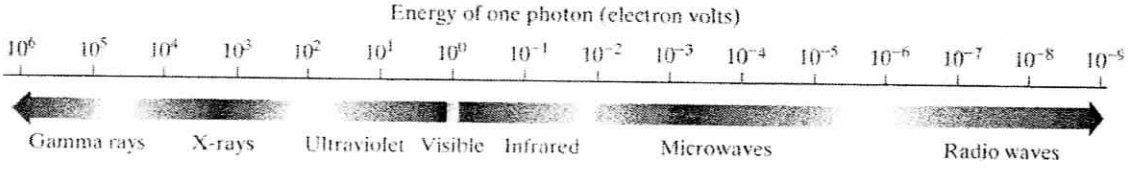

Figure 2.1: The electromagnetic spectrum arranged according to energy per photon

2.1.1.1 Gamma rays imaging

Gamma-rays imaging are used to examine things which are happening that cannot be seen with ordinary telescopes and helps to understand how matter and radiation interact with each other. As examples, gamma rays imaging is used for nuclear medicine and as astronomical observation. From this features, this image could locate sites of bone pathology such as infections or tumors. Figure 2.2 shows the examples of gamma ray imaging. [2]

Figure 2.2: Examples of gamma ray imaging

2.1.1.2 X-ray imaging

X-ray imaging is the oldest and most frequently used form of medical imaging. X-rays can produce diagnostic images of the human body on film or digitally on a computer screen. X-ray imaging is the fastest and easiest way for a physician to view and assess broken bones, joint or spine injuries. At least two images (from different angles) are taken and often three images are needed if the problem is around a joint (knee, elbow or wrist). X-ray imaging is best known used in medical diagnostic, but they are also used in other fields such as astronomy and x-ray packages at the airport. Figure 2.3 shows the examples of X-ray imaging. [2]

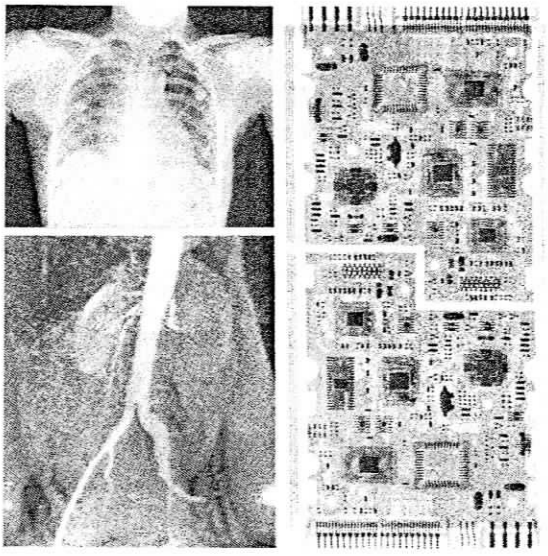

Figure 2.3: Examples of X-ray imaging

2.1.1.3 Imaging in the ultraviolet band

In ultraviolet band there are many applications could be done with image. Some of the applications are lithography, industrial inspections, microscopy, lasers, biological imaging and astronomical observations. Figure 2.4 shows the examples from the imaging of microscopy and astronomy.

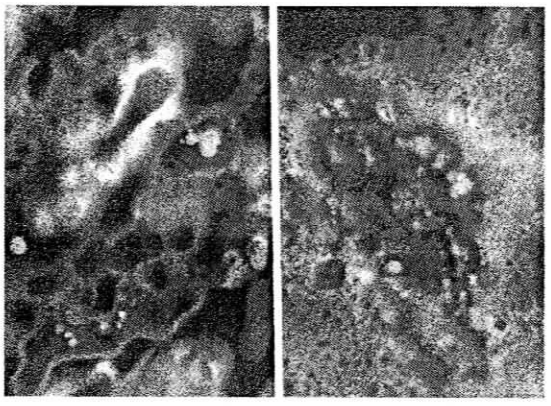

Figure 2.4: Examples from the imaging of microscopy and astronomy

2.1.1.4 Imaging in the visible and infrared bands

In this electromagnetic spectrum, it is the most familiar in our activities. The visible and infrared bands is combined because of the infrared band is often used in conjunction with visual imaging. Figure 2.5 shows the examples from the imaging of visible and infrared bands.

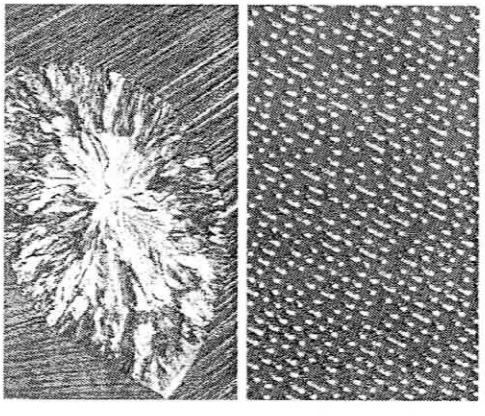

Figure 2.5: Examples from the imaging of visible and infrared bands.

2.1.1.5 Imaging in the microwave band

Application that used imaging in the microwave band is radar. Image from radar have the advantage of not being effect by weather or ambient lightning conditions. Radar has the ability to collect data of any region at any time. Figure 2.6 shows radar image of mountains.

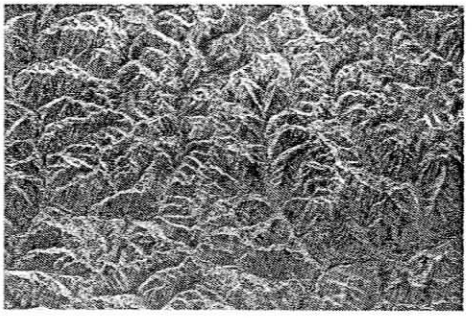

Figure 2.6: Radar image of mountains

2.1.1.6 Imaging in the radio band

Imaging in radio band applications is similar to the gamma rays that are for medicine and astronomy. As an example is the Magnetic Resonance Imaging (MRI) machine. The MRI could produce a picture in any plane such as Figure 2.7.

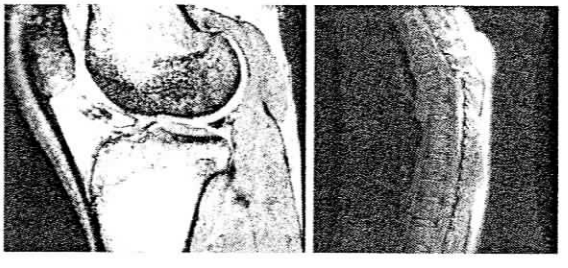

Figure 2.7: Examples of picture produced by MRI.

As the wavelength is compiled together, the differences of imaging in the varying wavelength of electromagnetic spectrum could be seen in Figure 2.8.

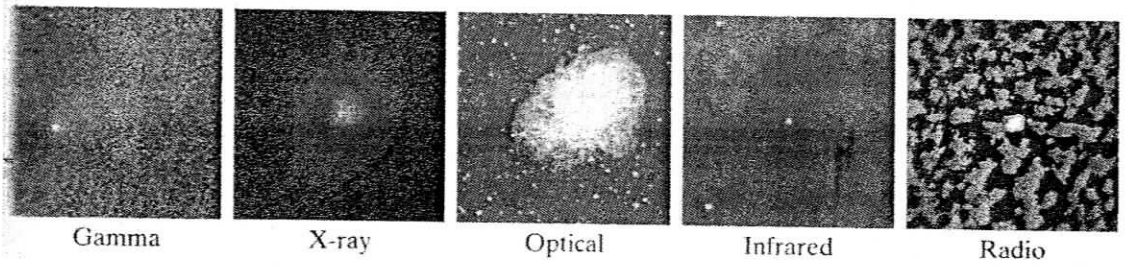

Figure 2.8: Examples of the differences of imaging in the varying wavelength of electromagnetic spectrum of the Crab Pulsar image.

2.1.2 Fundamental steps in digital image processing

Actually there are two broad categories in digital image processing. One is methods whose input and output are images. Second is a method whose input maybe images, but output is attributes extracted from the input images. Each of these categories has several processes or methodology could be applied to image with different purposed and objectives. Figure 2.9 will show the relationships between them. [2]