

**IMAGE RESTORATION USING MEAN, MEDIAN AND ADAPTIVE
FILTER**

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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FILTER**

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This report is submitted in partial fulfillment of the requirements for the Bachelor of
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DECLARATION

I hereby declare that this project entitled

IMAGE RESTORATION USING MEAN, MEDIAN AND ADAPTIVE FILTER

is written by me and is my own effort and that no part has been plagiarized without
citations

STUDENT: _____ DATE: _____
(ADELINE CHUA JIA MIN)

SUPERVISOR: _____ DATE: _____
(EN. OTHMAN BIN MOHD)

DEDICATION

To my beloved parents, friends and supervisor

ACKNOWLEDGEMENT

First and foremost, I would like to take this opportunity to express my highest gratitude and deepest appreciation to my dearest supervisor, Encik Othman bin Mohd. Sir, you had truly inspired me with countless of valuable guidance and advices throughout the whole process of this final year project. Your willingness and commitment had motivated me to contribute and work further for this project. Furthermore, your patience and understanding had helped me through all problems and obstacles that I faced during my difficult times. Sir, you did not just help me to solve but also gave me time and chances to modify, repair and improve my weaknesses shown in this project. For this, I would like to say, thank you so much Sir.

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ABSTRACT

Image Restoration is one of the many fields in Image Processing. The main purpose of Image Restoration is to recover an original image from a degraded image using the mathematical restoration and degradation model. Image Restoration techniques are divided into two domains namely the spatial domain and the frequency Domain. This project studies on the analysis of the Image Restoration using techniques of Mean, Median and Adaptive Filter under the spatial domain. Three different noises including Salt and Pepper noise, Gaussian noise, and Speckle noise are considered in this project to analyse the best noise that each of the proposed techniques are able to remove. The analysis is done by using the image qualities metrics such as MSE (Mean Square Error) and PSNR (Peak Signal to Noise Ratio).

ABSTRAK

Pemulihan imej merupakan salah satu bidang dalam Pemprosesan Imej. Tujuan utama Pemulihan Imej adalah untuk memulihkan imej yang asal daripada imej degradasi dengan menggunakan pemulihan matematik dan model degradasi. Teknik Pemulihan Imej dibahagikan kepada dua domain iaitu domain '*Spatial*' dan domain frekuensi. Kajian projek ini merupai analisis Pemulihan Imej menggunakan teknik penapis '*Mean, Median dan Adaptive*' di bahagian domain '*Spatial*'. Tiga 'noise' yang berbeza termasuk '*Salt and Pepper noise*', '*Gaussian noise*', dan '*Speckle noise*' akan digunakan dalam projek ini untuk menganalisis 'noise' yang terbaik bagi setiap teknik yang dicadangkan. Analisis ini dilakukan dengan menggunakan kualiti imej metrik seperti '*MSE (Mean Square Error)*' dan '*PSNR (Peak Signal to Noise Ratio)*'.

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LIST OF ABBREVIATIONS

TERM	EXPLANATION
MSE	Mean Square Error
PSNR	Peak Signal to Noise Ratio
RP	Research Problem
RQ	Research Question
RO	Research Objective

CHAPTER I

INTRODUCTION

Nowadays, image restoration plays an important role in today's society especially in the field of photography. With the development and usage of Smartphone in every nook and cranny, many photo editing applications has been developed due to the build in camera that allow users to snap pictures at anytime and anywhere. Unfortunately, some of the image taken by those cameras could be affected by noise or blurriness due to random factors of the camera sensor. Noise refers to unwanted information displaying on the image which ruins the image quality. The effects of noise are caused by malfunctioning pixels in camera sensors, transmission of image in some noisy channels or faulty memory locations in hardware. A method was introduced to restore a noisy image which known as Image Restoration. Image Restoration is a field in Image Processing which deals with recovering an original image by sharpening the image from a degraded image using a restoration model and mathematical degradation. There are many filters used in image restoration and different filters are only suitable for different types of degradation model. To investigate further, the analysis was conducted using Mean Filter, Median Filter and Adaptive Filter under Spatial Domain. The aim of the analysis is to determine the best techniques or filter to be used to restore an original image along with their advantages and disadvantages for the given image.

1.1 Project Background

In recent years, the technology of image processing has been developed and evolved as a factor of the evolution of the world. Image processing plays an important role to many fields especially in multimedia and national security. The field of image processing refers to processing digital image by means of a digital computer (Khare & Nagwanshi, 2012). In simple words, the act of Image processing is to change the nature of a digital image by using a computer. It includes many techniques such as Image Recognition, Image Segmentation, Digital Composition, Image Differencing and Morphing, Image Compression, Image Restoration and etc.

Image Restoration is a field of Image Processing which deals with recovering an original and sharpens image from a degraded image using a mathematical degradation and restoration model (Kaur & Chopra, 2012). In other words, image restoration is the process of taking an original image with known, or estimated degradation, and then restoring it back to its original form. Image restoration is often used in the field of publishing or photography where an image was somehow degraded but needs to be improved before it can be printed (Khalaf & Sagheer). The techniques used for image restoration are depends on the model of degradations used to obtain an approximation of the original scene. There are many factors that could cause degradation of an image and image restoration in one of the key fields in today's Digital Image Processing due to its wide area of application (Khare & Nagwanshi, 2012). Noise, motion and blur are examples of degradation model.

The restoration techniques comprise of a variance of filters used to restore the degraded image back to its original form. The filters are divided into two domains, mainly Spatial Domain and Frequency Domain. Filtering in spatial domain is known as spatial filter. This technique consists of a neighbourhood along a pre-defined operation that performs on the image pixels defining the neighbourhood (Tcheslavski, 2008). Spatial Filtering is a technique that you can use to sharpen, blur, smooth, or search for the edges of an image. It is typically use for the noise removal of digital images and to perform some sort of image enhancement. On the other hand, frequency domain is carried out via the Fourier transform. The main concept behind the Fourier transform is that by using a sum of cosine and sine waves of

different frequencies, it can construct any sort of waveform in that matter. Several examples of spatial filtering are Mean Filter, Median Filter, Average Filter, Rank-order Filter and Adaptive Filter. However in frequency domain, examples of the filters are like Inverse Filter, Weiner Filter and Regularized Filter. Thus in this project, only spatial domain filtering techniques will be focused on.

1.2 Problem Statement

Image restoration plays an important role in today's society. It is no longer a new image processing technology used to filter image nowadays. However, image restoration covers a wide range of filter techniques. It also requires some knowledge on basic image processing terms that are using. To justify and determine a specific technique to be applied on a certain image are not easy. Hence, a few research problems are listed as shown in Table 1.1.

Table 1.1: Summary of Problem Statement

RP	Research Problems
RP1	Difficulty to understand the use of each of the proposed techniques.
RP2	Difficulty to identify which type of noise is suitable to be used by each of the proposed techniques.
RP3	Difficulty to compare the final output after restoration has been done.

As we can see from Table 1.1, three research problems were conducted to clarify for the research question. The elaboration for each of the Research Problem (RP) is explained as follow:

RP1: Difficulty to understand the use of each of the proposed techniques.

The ideal and knowledge of the proposed techniques were yet to be discovered. Hence it is difficult to know what were the used for each of the proposed techniques and how does it performs.

RP2: Difficulty to identify which type of noise is suitable to be used by each of the proposed techniques for restoration.

In order to determine how the proposed techniques can be able to restore a degraded image, the type of noise that are suitable to be removed for each techniques were analysed further.

RP3: Difficulty to compare the final output after restoration has been done.

The comparison of the final output could not be done if the both RP1 and RP2 are not solved.

1.3 Research Question

Based on the research problems above in Table 1.1, the research questions were identified as shown in Table 1.2 below.

Table 1.2: Summary of Research Questions

RP	RQ	Research Questions
RP1	RQ1	What are the uses of each of the proposed techniques?
RP2	RQ2	Which type of noise is best removed by each of the proposed techniques?
RP3	RQ3	How to compare the final output after restoration has been done?

The elaborations for each of the Research Questions (RQ) are discussed as follow:

RQ1: What are the uses of each of the proposed techniques?

This research question is to analyze the use for each of the proposed techniques used in this project.

RQ2: Which type of noise is best removed by each of the proposed techniques?

This research question is to identify the type of noise that is best removed by each of the proposed techniques.

RQ3: How to compare the final output after restoration has been done?

This research question is to compare the final output after restoration has been done.

1.4 Objective

According to the research problems and research questions stated in section 1.2 and 1.3, three objectives are conducted as shown in Table 1.3.

Table 1.3: Summary of Research Objectives

RP	RQ	RO	Research Objectives
RP1	RQ1	RO1	To analyze each of the proposed techniques.
RP2	RQ2	RO2	To identify the type of noise that is best remove by each of the proposed techniques.
RP3	RQ3	RO3	To compare the final output after restoration has been done

Further explanation for each of the Research Objectives (RO) is explained as follow: