A Smart Image Enhancement Monitoring System Using Graphical User Interface (GUI)

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Abstract. Image filtering is one of the methods used in image processing. It is also can be called as image enhancement. Filter help the problems of the image display and can improvise the quality of the image. The problems that always happened in the image is illumination, noise and under-light images. In addition, these problems also caused a few troubles for image recognition for the daily life of certain people for their work. The purpose of this study is to apply the mathematical algorithm of the filters, identifying the best method of the filters and simulate the result of the image quality assessments in Graphical User Interface (GUI) and Global System for Mobile Notification (GSM). Basically, image processing methods have specific mathematical algorithms. That is the main difference between these methods. For this paper, two types of image have been chosen which is document image and medical image. There were a few methods that were selected in this project. It is a high pass filter, low pass filter, and high boost filter. Thus, homomorphic filtering was applied to that filter. Then, the enhanced images would be simulated to the selected parameters of image quality assessments (IQA). The selected parameter of the image quality assessment is a global contrast factor (GCF) and signal to noise ratio (SNR). If the value of the parameters satisfies its characteristic, the method would be selected as the most suitable method for the image. Meanwhile, the best result will be selected as the best image for this study.

Keywords; contrast variation, illumination, noise, filter, image, GUI

1. Introduction

One of the most significant current discussions in image processing is an image enhancement process. Previous studies have primarily concentrated on the filtering technique as the main enhancement development. The most filtering technique can find the important perception that each pixel of the output image is computed from a local region of the matching pixel in the input image. The perseverance of filtering is to remove noises and increase the quality display of the image [1–3]. Many an experimental investigation was conducted in the past few years to explore visual qualities. It has played a key part in image considerate because they carrying important semantics of images. Other than that, it is because quality demonstrations that group local image descriptors in order less way have had a great impact on diverse applications [4]. Besides, filters describe the procedures to improve images for either human consumption or for further automatic actions [5]. In this decade, applying the
recognition of fingerprint by many people in their day to day life. It is for authenticating a demanded personality in commercial uses such as verifying identity at workspaces or public library, entrance counters at fun parks or zoos and to turning on notebooks, tablets or mobile phones. Most fingerprint recognition systems are based on minutiae as features for comparing fingerprints [6]. Image filtering and segmentation are very useful for that to make improvement for recognition of the fingerprint image [7].

In addition, the filter also has been used in the medical field [8–10]. So, the doctors will need this study to process an image to heal some disease. However, to solve the illumination problem Ardizzone et.al [11] as well suggested homomorphic filtering method. This homomorphic filtering method is suggested to develop the basic homomorphic filtering function to enhance the quality of the image [12]. Nevertheless, filters also used for document image [13–15]. It will be helpful for some people that in charge of something ancient goods or old artifacts such as lawyers, archeologist, artist and many more. Mostly, the ancient documents will have typewriting that cannot read because the paper was too old. So, the filtering methods will help to solve the problem by removing those noises and unwanted display on the document image. The primary purpose is to study the function and mathematical equation for different filtering technique. In this experimented 5 types of filtering technique was selected and tested on two dataset image which is medical (cell) and document images. A few image quality assessment was calculated in order to prove the resulting performance (SNR and GCF). This paper consists of 5 sections. Section II explained about methodology, section III discuss details result and section IV explain the monitoring system and the last section will summarize the overall work.

2. Methodology

2.1 Low Pass Filter (LPF)
An LPF also named a blurring or smoothing filter. Its image will look a lot blurrier. Even how good the camera is, it will always add an amount of snow or noise into the image. The numerical nature of light itself also donates noise into the image [16].

2.2 High Pass Filter (HPF)
HPF can make the identical technique as LPF with an, unlike complication kernel. In fact, Fourier HPF is applied to detach low-frequency illumination from high-frequency reflectance. The main purpose of using the high pass filter is to stop the low-frequency component while the high-frequency component is passing in the signal [17].

2.3 High Boost Filter (HBF)
High boost filtering of a black & white image included time domain image sharpening techniques. It is frequently necessary to underline high-frequency parts demonstrating the image data by means such as refining minus removing low-frequency modules demonstrating the simplest form of the signal. In this case, the HBF can be used to filter high-frequency parts while unmoving the low-frequency parts [18].

2.4 Homomorphic Filtering
This method is a typical method for filtering and improvement of the image. It stabilizes the illumination of the image and improves the contrast while illumination is the components that could not be excluded [18]. There are two components to apply to improve the unwanted presence simultaneously which is the illumination and contrast [19,20].

3. Result
The discussion of the results begins with a resulting image as shown in Figure 1. A few selected images displayed after applying the different filtering process. On original cell images, the intensity value of background and cytoplasm almost similar. Based on observation, cell image from Homomorphic Low Pass Filter (HLPF) technique is smooth, uniform and less noise compared to the other filtering techniques. The finding provides evidence that the range of intensity level between foreground and background will influence the filtering process. While document image result shown that the High Pass
Filter (HPF) is more effective in dealing with the unwanted signal and dark spot on the image compared to the other's technique.

| Type of filter | Image |
|----------------|-------|
| Original image | ![Original Image](image1.png) ![Original Image](image2.png) ![Original Image](image3.png) |
| LPF            | ![LPF Image](image4.png) ![LPF Image](image5.png) ![LPF Image](image6.png) |
| HPF            | ![HPF Image](image7.png) ![HPF Image](image8.png) ![HPF Image](image9.png) |
| HHPF           | ![HHPF Image](image10.png) ![HHPF Image](image11.png) ![HHPF Image](image12.png) |
| HLPF           | ![HLPF Image](image13.png) ![HLPF Image](image14.png) ![HLPF Image](image15.png) |
| HHBF           | ![HHBF Image](image16.png) ![HHBF Image](image17.png) ![HHBF Image](image18.png) |

**Figure 1.** Comparison of different types of the filter of the document image
Table 1. Comparison of GCF & SNR value using different filtering methods

|                | Average |          |          |          |          |
|----------------|---------|----------|----------|----------|----------|
|                | LPF     | HPF      | HHPF     | HLPF     | HHBF     |
|                | GCF     | SNR      | GCF      | SNR      | GCF      | SNR      | GCF | SNR | GCF | SNR |
| 10 Medical     | 3.10    | 6.69     | 2.49     | 7.96     | 2.79     | 7.55     | 1.908 | 8.45 | 2.71 | 7.57 |
| Images         |         |          |          |          |          |          |       |     |     |     |
| 10 Document    | 3.12    | 7.70     | 2.55     | 8.79     | 2.90     | 8.03     | 2.22  | 9.36 | 2.59 | 8.64 |
| Images         |         |          |          |          |          |          |       |     |     |     |

In order to prove the efficiency of the filtering technique, two image assessment was obtained which is Global Contrast Factor (GCF) and Signal Noise Ratio (SNR). The equation for both image assessment above can be referred on [21]. The result evaluation was presented in Table 1. The higher of SNR [22,23] and lowest GCF [24,25] represent the good image quality with uniform intensity and low noise. Based on Table 1, the higher (SNR) and lowest (GCF) came from Homomorphic Low Pass Filter (HLPF) technique compared to others technique. However, for the document data set, the High Pass Filter (HPF) is more efficient (SNR = 8.79 and GCF = 2.55) compared others.

4. Monitoring System

Figure 2 below shows the process flow of the filtering process and monitoring system. It will start by choosing an input image to be a filter and the image will display on the box axes 1. After that, the user needs to choose the type of filter that is a process. While the filter was selected, automatically display the output on the box axes 2. The value of GCF and SNR also will display on that GUI layout figure after the output image was read by the MATLAB software. Figure 3 shows the editor of GUIDE before it runs the GUI Figure simulation.

GUI is a software simulation in MATLAB. The simulation to run the application provided specific MATLAB language or a variety of commands as instruction. It is autonomous MATLAB programs with GUI to simulate the application. Basically, GUI has the commands to controls for example sliders, menus, buttons, and toolbars. In this section, GUI simulation was used to show the resulting image and IQA compared to other filtering types. Figure 4 shows the simulation of the document image with the SNR and GCF value. The selected images able to compare automatically to compare the original image and the filtered image by using the selected filters. In addition, the value of SNR and GCF also can be displayed on the layout of GUI Figure 4. Besides, the output image also can be saved to the drive and other storage.

Figure 2. GUIDE Process Flow of the Filtering System
5. Conclusion

This paper has shown that an overview of the background and related work in the area of image enhancement. This report mostly concentrated on the 5 different methods of filters such as LPF, HPF, and HBF. The operational method creates the main parameters that have been experimental on 20 types of images which is included document images and medical image. The experimental reflection was under SNR and GCF displays the efficiency of the filter performance. The result of this study exposes that Homomorphic HLF provides better performance among the other filters in terms of GCF and SNR value for the cell images. A smart monitoring system using GUI was applied. This system can be replaced as a patient monitor in a hospital. This system is more friendly and easy to use. Moreover, these project findings also offer for future research to improve more technology implementation. Maybe, the future project is put internet of thing (IOT) for this project. It is due to the very advanced
lifestyle people in this world and they really need this application for their needs. It is also to help some people to send information to other places without any problems and get a response as fast as possible.

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