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DE-NOISING OF DERMOSCOPIC IMAGES FOR AUTOMATIC SKIN CANCER DETECTION USING DIGITAL IMAGE PROCESSING

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Abstract--Nowadays, skin cancer is one of the unrestrictive spreading diseases. Melanoma skin cancer has the maximum fatality rate in contrast with other variety of cancers. Detection of Melanoma in the initial stages can improve survival rate to a greater extent. The fundamental scrutiny of melanoma is very crucial to take relevant medication. Hence, there is a requirement for automatic skin cancer recognition procedure with high efficiency. The complications of melanoma detection can be handled by the use of excellent Digital image processing algorithms, which are extremely beneficial to clinicians during the disease diagnosis process. The de-noising of an image is a complicated pre-processing task, to preserve minute details in the acquired images which occupy the images during image acquisition in digital image processing applications. The use of a proper de-noising filter allows for the preservation of tiny details in the image, which is beneficial for feature extraction. Especially in the domain of dermoscopic image processing, the better de-noising technique is necessary to maintain the fine details in the image. In general the dermoscopy images are not clear due to improper resolution adjustments and light focusing during image acquisition. Most of the dermoscopic images are diminished by Gaussian type of noise. In this present work, three different types of noise have been added to the acquired image and de-noised by the use of linear filters. The performances of various de-noising filters are evaluated with variables such as Mean-Square-Error (MSE), and Peak-Signal-to-Noise Ratio (PSNR).

Keywords: Dermoscopic, Image De-Noising, MSE, PSNR.

Introduction

Today skin cancer is one of the massively spreading diseases. It is the cancer that affects melanocyte cells which are subsequent for generating skin pigment called melanin. Melanoma affected skin lesions can be spotted by the inspecting of transition in shape, size, color, texture etc of the skin. Melanoma is a perilous formation of skin cancer that leads with a black spot, looks like a mole. Formation generally begins with variations in pure lesion, size variations, improper edges, itching sense, cracks in skin, and altering color [3].

According to the American Cancer Society, cancer facts and figures report 2021 that new melanomas would affect 106,110 persons and 34,920 people's deaths are expected from melanoma. The maximal melanoma ratio was noticed in Australia, Europe and North America continents, and minimal ratio in Africa, South America and Asian continents.

The skin lesion may be identify as benign, atypical and melanoma types. In these types benign skin lesion is a regular unaffected skin, atypical type may be suspected as cancerous and melanoma is accepted as cancerous.

Premature observation of melanoma skin cancer can guide to early medical diagnosis and treatment. Hence, there is a requirement for highly accurate automatic skin cancer recognition system. It can further avert the advancement of cancer to next stage. Various Digital image processing techniques has been developed in the areas of medical diagnosis, it is possible to recognize and avert the skin cancer in advance.

Recently, telemedicine has become more popular, due to noticeable development of digital technologies. Nowadays because of the COVID-19 diseases, with physical isolation protocols, the telemedicine is the secure connected system between patients and physicians. This pandemic rose the importance of remote monitoring of patients. The recent advanced developments particularly in the field of digital image processing technologies enables telemedicine can also be used in the automatic skin cancer detection process. Particularly this enables the physicians for periodic monitoring of chronic patients and patients can access specialists from the home. The implementation of Digital image processing methods for automatic skin cancer detection from images reduces manmade errors and improves the speed of detection [8]. Apart from image processing techniques, the latest developing Artificial Intelligence (AI) based strategies and Machine learning (ML) classifiers are also contributing in the detection of skin cancer.

Proposed Methodology

The dermoscopic image features known as ABCD rule are useful in detection of skin lesion types. ABCD rule of dermoscopic images was based on the criteria variables named as asymmetry-A, border-B, color-C, and differential structure-D, for improved diagnostic accuracy. ABCD rule is reliable procedure for automatic detection of skin cancer. Digital image processing procedures are useful to identify cancerous tissues using ABCD rule.

Image capture, image pre-processing, skin lesion segmentation, feature extraction, and classification of skin lesions into benign, atypical, and melanoma are the major phases in image processing in this applications [1]. Noise detection and exclusion is an essential primary step in the skin cancer image analysis system. The appearance of noise on skin lesion will make a barrier for effective lesion segmentation and feature extraction, which will generate an inaccurate outcome of the system. The proposed methodology for skin lesion detection is given in below flowchart as in fig1.

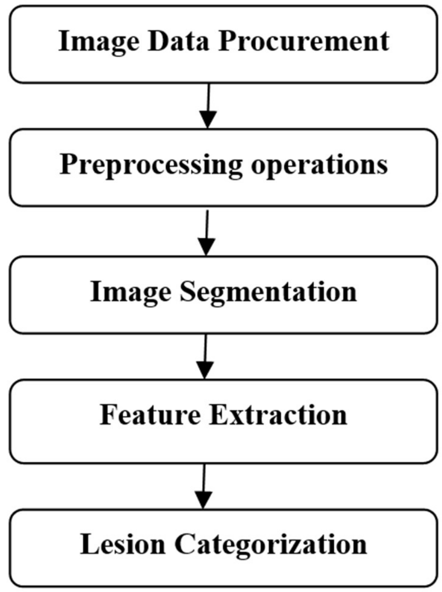

Fig 1: skin lesions classification process flow

Image de-noising is a crucial image pre-processing operation i.e. as a process itself as well as one component among other processes. There are number of methods to de-noise an image exists. The main aspect of a good image de-noising process is that it should completely remove noise as far as possible as well as preserve edges. The main goal of this preprocessing operation is to erase or minimize the unwanted parts of the image or the background.

Conventionally, linear and non-liner models are used for noise cancellation, in which linear models are preferred. The key benefit of linear models is its response time, and the constraint of the linear model is, these models are not able to retain edges of the images i.e. the edges are wiped out. On the other side, Non-linear models can handle edges in a better manner than linear models. Image de-noising is one of the preliminary tasks, in general performed before segmentation and feature extraction process. Typically the noise can be categorized as Gaussian, Rayleigh, Erlang (Gamma), Exponential, Uniform and Impulse noise. All the noises are characterized by their probability density function. There is no common noise removal tool for all kind of noises and also the same method may not work well for the images from different domains such as medical, astronomical, radiographic and satellite. It is a big challenge to identify a de-noising filter suitable for all images from one particular domain.

In this work the dermoscopic image is added with three types of noises like Gaussian noise, Salt & Pepper noise and Speckle Noise. After addition of different noises and De-noising was performed using linear filters such as Gaussian filter and median filter on the image. De-noising removes of undesired elements like small particles, hair etc.,.

The image database was acquired by obtaining images from several websites [4,5].These websites are listed for melanoma skin cancer images.

Performance Evaluation Criteria

The performance evaluation of the generated results is analyzed by calculating the Signal to noise Ratio (SNR), Peak Signal to Noise Ratio (PSNR) & Mean Square Error (MSE) of the filtered image.

Mean Square Error (MSE)

It is used to correlate the original image and filtered image. The MSE is the sum of squared error between original and filtered image. The lower the value of MSE means least error produce in the image.

The Mean-Square-Error (MSE) of an image is expressed below:

$$\mathbf{MSE} = \frac{1}{PQ}\sum_{i=1}^{P}\sum_{j=1}^{Q}\left[I(i,j) - \bar{I}(i,j)\right)^2$$

Where, P & Q stand for horizontal and vertical aspects of the image; I is the original faultless image and I is the filtered image.

Peak Signal-to-Noise Ratio (PSNR)

It is contrary to MSE, higher value of PSNR reflects signal to noise ratio is higher. Hence the MSE value should be minimum and PSNR value should be maximum for the image filtering.

The Peak-Signal-to-Noise-Ratio (PSNR) of an image is expressed below:

$$\mathbf{PSNR} = 10 * \log_{10}\frac{255^2}{MSE}$$

Implementation Results & Analysis

The Original dermoscopic image shown in Figure2, which is obtained from internet sources and it, is added with three categories of noises like Gaussian noise, Salt & Pepper noise and Speckle Noise. After addition of different noises and De-noising was performed using linear filters such as Gaussian filter and median filter on the image using MATLAB software and MSE, SNR & PSNR are calculated. Calculating and analysis of Signal to noise Ratio (SNR), Mean-Square-Error (MSE), & Peak Signal to Noise Ratio (PSNR) of the filtered image was shown in the tables.I & II and Filtered images are shown from fig. 2 to 7.

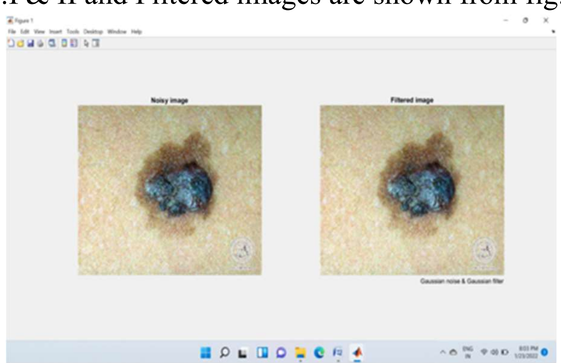

Fig 2. Gaussian noise is added to the Original image and Gaussian filtered image

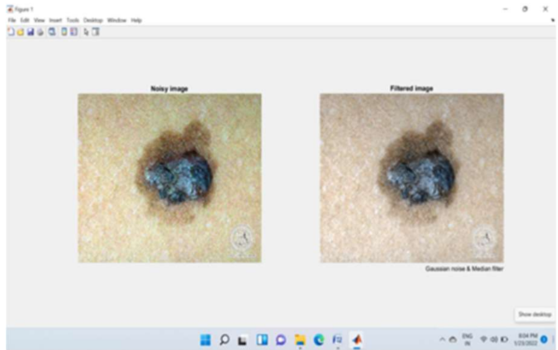

Fig 3. Gaussian noise is added to the Original image and Median filtered image

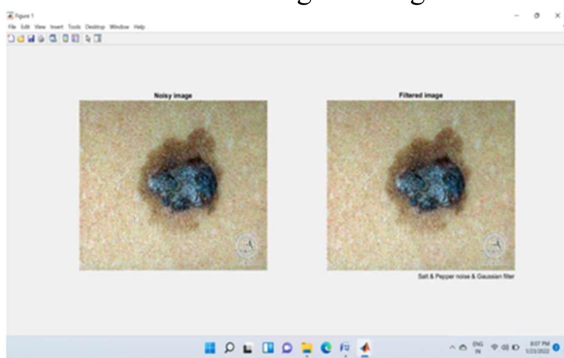

Fig 4. Salt & pepper noise is added to the Original image and Gaussian filtered image

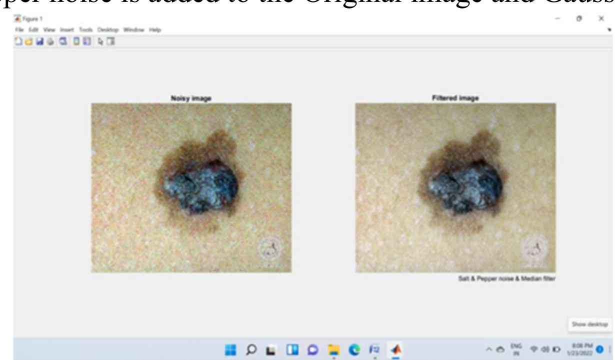

Fig 5. Salt & pepper noise is added to the Original image and Median filtered image

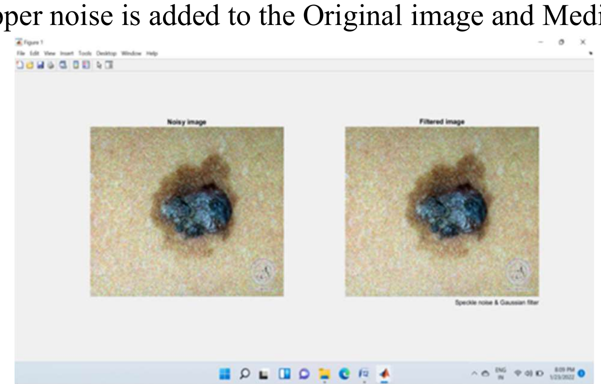

Fig 6. Speckle noise is added to the Original image and Gaussian filtered image

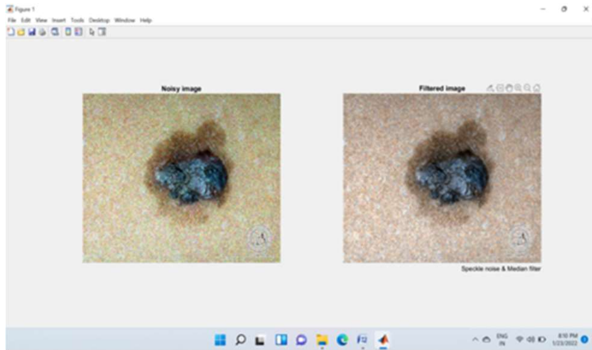

Fig 7. Speckle noise is added to the Original image and Median filtered image

Table I. Performance evaluation for the Gaussian filtered images

Name of the noise applied on original image	**Image**	**Original image**	**Filtered Image compared to original image**		
		SNR	***SNR***	***PSNR***	***MSE***
Gaussian Noise	Image1	14.66	18.36	21.94	415.13
	Image2	16.45	17.48	21.83	426.55
	Image3	16.99	18.38	21.85	424.60
	Image4	16.14	18.35	21.88	421.49
	Image5	16.36	18.01	21.87	427.91
	Image6	13.11	17.60	21.87	421.79
Salt & pepper Noise	Image1	14.66	18.25	21.83	425.85
	Image2	16.45	18.04	22.39	374.76
	Image3	16.99	18.49	21.96	413.61
	Image4	16.14	18.49	22.02	407.90
	Image5	16.36	18.18	21.98	411.53
	Image6	13.11	17.55	21.83	426.18
Speckle Noise	Image1	14.66	20.70	17.12	553.10
	Image2	16.45	16.89	21.24	487.79
	Image3	16.99	17.00	20.47	582.73
	Image4	16.14	17.01	20.54	573.42
	Image5	16.36	16.96	20.76	545.72
	Image6	13.11	17.04	21.32	479.68

Table II. Performance evaluation for the Median filtered images

Name of the noise applied on original image	**Image**	**Original image**	**Filtered Image compared to original image**		
		SNR	***SNR***	***PSNR***	***MSE***

Gaussian Noise	Image1	14.66	19.00	22.58	358.38
	Image2	16.45	19.58	23.93	262.68
	Image3	16.99	19.57	23.06	321.41
	Image4	16.14	19.73	23.26	306.50
	Image5	16.36	18.97	22.77	342.94
	Image6	13.11	19.12	23.39	297.25
Salt & pepper Noise	Image1	14.66	24.54	28.12	100.17
	Image2	16.45	30.94	35.29	19.20
	Image3	16.99	25.02	28.49	91.92
	Image4	16.14	26.25	29.78	68.34
	Image5	16.36	24.12	27.92	104.94
	Image6	13.11	25.36	29.64	70.60
Speckle Noise	Image1	14.66	19.28	22.86	336.14
	Image2	16.45	20.56	24.90	209.93
	Image3	16.99	19.83	23.30	303.80
	Image4	16.14	20.10	23.63	281.48
	Image5	16.36	19.53	23.33	301.73
	Image6	13.11	19.90	24.18	248.03

Conclusion

In this work, the Gaussian-noise, salt & pepper-Noise, speckle-noises were added to the dermoscopic images and the same were filtered. The performance of all filters was analyzed in view of parameters Signal-to- noise ratio (SNR), Peak--Signal-to-Noise Ratio (PSNR) and Mean-square- error (MSE).It is observed that median filter performance is good i.e. it has high SNR, PSNR values and Low MSE value. Hence we conclude median filter can be preferred for the noise reduction in the dermoscopic images.

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