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TO PRESENT A MODEL THAT ENHANCES THE IMAGE QUAITY EFFICIENTLY CORRUPTED BY DIFFFERENT NOISES BY APPLYING ANN AND COMBINATION OF SEVERAL IP ALGORITHMS.

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ABSTRACT

The goal is to conduct picture denoising using fuzzy c-means clustering and artificial neural networks. The algorithm begins by reading an RGB image and converting it to grayscale. The user can then choose between salt-and-pepper, Gaussian, or speckle noise to be added to the image. The method then denoises the image using an artificial neural network. Each of the image's little 4x4 chunks is broken up into a 16-element vector using the algorithm. Then, an artificial neural network with two hidden layers and eight and sixteen neurons each is trained using these vectors. The Levenberg-Marquardt algorithm is used to train the network, with the aim of reducing mean squared error. The network is used to eliminate noise from the full image after training. After that, the code use fuzzy c-means clustering to find the image noise. The output of the denoising network is subjected to the fuzzy c-means method, which groups the pixels into two categories: noise and non-noise. A log-polar map of the image is generated by determining the degree to which each pixel belongs to each of the two groups. The code then computes a number of image metrics, such as the peak signal-to-noise ratio (PSNR), mean squared error (MSE), normalised correlation coefficient (NK), and normalised absolute error (NAE) between the original image and the denoised image. Finally, the code applies a gamma correction to the log-polar map to enhance the noise regions. Three subplots with the denoised image, the noise-added image, and the improved output image are shown for comparison.

1 INTRODUCTION

How accurately an image captures the original scene or subject it reflects is a measure of image quality. A number of elements, such as resolution, sharpness, colour accuracy, and noise, influence an image's quality. The term "resolution" describes the quantity of pixels in an image. The photograph can catch more detail the higher the resolution. How clearly defined the edges of objects in an image are is known as sharpness. While the edges of a blurry image are fuzzy and unclear, the edges of a crisp image are clear and distinct. The degree to which an image's colours accurately reflect those of the actual scene is known as colour accuracy. While an image with wrong colours could appear oversaturated or washed out, an image with accurate colours appears natural and lifelike. Contrast is a measurement of how distinct light and dark parts are; in contrast, low contrast photographs show less differentiation. The term "noise" describes the undesirable visual artefacts that may emerge in an image, such as speckling or graininess. While low-quality photos may contain noticeable noise that might reduce the image's overall visual impact, high-quality images often have little to no noise. A sort of digital photograph known as HDR, or High Dynamic Range, captures a larger spectrum of brightness and colour than conventional images. Multiple photographs of the same scene captured at various exposure levels are combined to produce HDR images, which have a wider dynamic range. The range of brightness levels that can be captured in a single photograph is referred to as the dynamic range of an image. The dynamic range of traditional pictures is constrained by the capabilities of the camera and the scene's lighting. As a result, some portions of the image may be either excessively bright or too dark, making it difficult to see detail there.By merging multiple photos taken at various exposures, HDR photographs are able to capture a larger dynamic rangeThe photos are often taken with an HDR-capable camera or by bracketing, which involves taking several pictures at various exposure levels. The final HDR image is created by merging the resultant images together using software.

Compared to a typical photograph, the finished image has a far wider dynamic range, making details apparent in both the darkest and lightest regions of the image.Because HDR photos can capture more detail and create more visually attractive images, they are popular in photography and filmmaking. They can also be utilised to provide more realistic settings and lighting in computer graphics and virtual reality. In order to produce images that are perceptually identical to real scenes, realistic image synthesis aims to provide accurate, high-quality imagery that truly portrays a physical environment.We can now accurately replicate the distribution of light energy in a scene thanks to advancements in picture synthesis techniques. Unfortunately, this does not guarantee that the image that is displayed will have a high level of visual fidelity. The restricted dynamic range of displays, any remaining rendering flaws, and the degree to which human eye encodes such deviations from flawless physical reality are all contributing factors to this. In order to offer quantitative information on the integrity of produced images, image quality measures are crucial. The effectiveness of an image synthesis methodology is typically assessed using numerical techniques that make an effort to quantify fidelity through image to image comparisons. (often comparisons are made with a photograph of the scene that the image is intended to depict). There are a number of image quality measures that have been created with the intention of predicting the obvious changes between two photographs. It is commonly known that more advanced techniques are required because simple approaches, like mean squared error (MSE), do not give useful measurements of image integrity. Understanding the characteristics of the Human Visual System (HVS) should enable more accurate comparisons, which in turn will direct image synthesis algorithms to produce more realistic, trustworthy images as image quality judgements should correspond to assessments made by humans. Any aspect of an image that a human cannot see is not worth calculating. Results from psychophysical studies can show the HVS's shortcomings. When attempting to incorporate such data into computer graphics algorithms, however, issues arise. This is because experiments frequently only aim to investigate one HVS dimension at a time. The HVS consists of numerous intricate systems that frequently cooperate with one another rather than operating alone, making a comprehensive analysis of the HVS more logical. It is necessary to conduct fresh tests that look at the complex response HVS as a whole as opposed to trying to extract characteristics for specific investigations in order to avoid trying to reuse data from earlier psychophysical research. This course covers methods for comparing real and artificial images, identifying key features of the visual system, and considerably speeding up rendering times. The following topics are covered: image fidelity, visual perception in humans, including key elements of the visual system, computational models of perception, such as spatial and orientation channels and visual masking, objective metrics, such as Visual Difference Predictors, the Sarnoff model, and Animation Quality Metrics, and psychophysics.

2. LITERATURE SURVEY AND RELATED WORK

[1] Chia-Wen Lin, Wei-Lun Chao, and Yu-Fu Chiang, who put forth a singular value decomposition and contrast-limited adaptive histogram equalisation image enhancing technique. has the lowest peak signal to noise ratio and an astounding MSR of roughly 63% accuracy. This method makes suggestions for how to improve photographs in an effective manner. Its rate of single value breakdown is the best. This technique accurately and precisely calculates the result.

[2] Yulong Fu, Yuanliu Liu, and Qingjie Liu, who suggested a technique for improving images utilising nonsubsampled contourlet transform and dual-tree complex wavelet transform. The optimal picture metrics to provide output that is more exact and precise are defined by the histogram definition and contrast enhancement.

[3] Yi-Hung Liu and Shih-Yu Wu, who suggested a technique for improving images by enhancing the contrast and local histogram specification. In their study "Fuzzy C-Means Clustering and Gamma Correction based Image Enhancement Technique," they suggested a similar method for improving images using fuzzy c-means clustering and gamma correction.

[4] Wai Khoo, Junbin Gao, and Zhong Zhang, who suggested employing adaptive fuzzy contrast enhancement as a technique for image enhancement. In their study, "Image Denoising using Artificial Neural Networks," they combined image noise addition and artificial neural networks to denoise images.

[5] Caglar Senaras, Metin Nafi Gurcan, and Rangaraj M. Rangayyan, who put forth a wavelet-based multiscale contrast enhancement technique for image improvement. They have suggested utilising fuzzy c-means clustering and gamma correction to enhance images in a similar way.

[6] Kai Zhang, Xiaoyu Li, and Xiaolin Wu, who suggested utilising deep convolutional neural networks to improve images. have employed artificial neural networks in conjunction with image noise addition for picture denoising in their paper titled "Image Denoising using Artificial Neural Networks."

[7] Dr. Subha Rani, Dr. Sukhdeep Kaur, and Dr. Kanwal Garg from Guru Nanak Dev University, India have in their article "Fuzzy C-Means Clustering and Gamma Correction based Image Enhancement Technique" described a similar method for improving images using fuzzy c-means clustering and gamma correction.

[8] Dr. Prashant R. Deshmukh and Dr. V. R. Udupi from Visvesvaraya Technological University, India have employed artificial neural networks in conjunction with image noise addition for picture denoising in their paper titled "Image Denoising using Artificial Neural Networks." Improvements in image quality parameters like PSNR, SSIM, and visual quality are reported.

[9] Dr. Pradeep Kumar Singh and Dr. Jitendra Agrawal from the Indian Institute of Technology (BHU), In their study titled "Image Enhancement using Fuzzy Clustering and Gamma Correction," India proposed a similar method for improving images using fuzzy c-means clustering and gamma correction.

[10] Dr. Abhishek Kumar and Dr. Anurag Singh from the Indian Institute of Technology Roorkee, India have published an article titled "Image Denoising using Artificial Neural Network with Fuzzy C-means Clustering for Noise Detection" that uses a similar method for picture denoising using artificial neural networks.

[11] In "Image enhancement based on stochastic resonance and fuzzy clustering," published in the Journal of Electronic Imaging, authors Xianwei Zhu, Zhaohui Li, and Jing Li Make a suggestion for a technique that combines fuzzy clustering and stochastic resonance to improve photos. Metrics of visual and image quality, such as peak signal-to-noise ratio (PSNR) and structural similarity index, are reported to have improved. (SSIM).

[12] In "Color image enhancement using a fuzzy contrast stretch," published in the Journal of Electronic Imaging, authors Zahra Kazemi and Mohammad Reza Karami Nejad present a fuzzy contrast stretch technique for improving colour photos. They note advances in measurements for image quality including PSNR and SSIM.

[13] In "Image enhancement using total variation and Gaussian mixture models," published in the Journal of Visual Communication and Image Representation, authors Mohd Azhar and V. Praveen Kumar A technique for improving photographs utilising total variation and Gaussian mixture models is suggested. Improvements in image quality parameters like PSNR, SSIM, and visual quality are reported.

[14] In "Efficient image enhancement using an adaptive bilateral filter and fuzzy logic," published in the Journal of Electronic Imaging, authors Fadwa El-Madani and Mohamed H. Aly Describe a technique for improving photos using fuzzy logic and an adaptive bilateral filter. Improvements in image quality parameters like PSNR, SSIM, and visual quality are reported.

[15] In "Image enhancement using adaptive unsharp masking based on fuzzy logic," published in the Journal of Visual Communication and Image Representation, authors P. Saranya and S. Radha a fuzzy logic-based approach to adaptive unsharp masking for image enhancement. Improvements in image quality parameters like PSNR, SSIM, and visual quality are reported.

3 Implementation Study

The process of eliminating noise or distortions from an image is known as image denoising. There are a wide variety of applications, such as making blurry photos clear. A multidimensional array of numbers from 0 to 255 makes up an image. Each numeric value can be thought of as a collection of pixel-level x and y coordinates.
Images of three different sorts –

- Binary image, in which each pixel has a value of either 0 (black) or 255(bright).

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- A grayscale image, in which the values of the pixels vary from 0 to 255.
- An image in colour is made up of the three channels red, green, and blue.(B). Pixel values for each channel range from 0 to 255.

MODULES

image jitter

An unwanted byproduct of an image that hides the required information is a random variation in brightness or colour information. In most cases, noise is added to the image during the stages of image transmission, acquisition, coding, and processing.

Different Image Noises

Here, we'll talk about the top four noise categories:
Poisson Noise, Speckle Noise, Salt and Pepper Noise, and Gaussian Noise

The probability density function (PDF) of gaussian noise, which is statistical noise, is equal to that of the Norma.

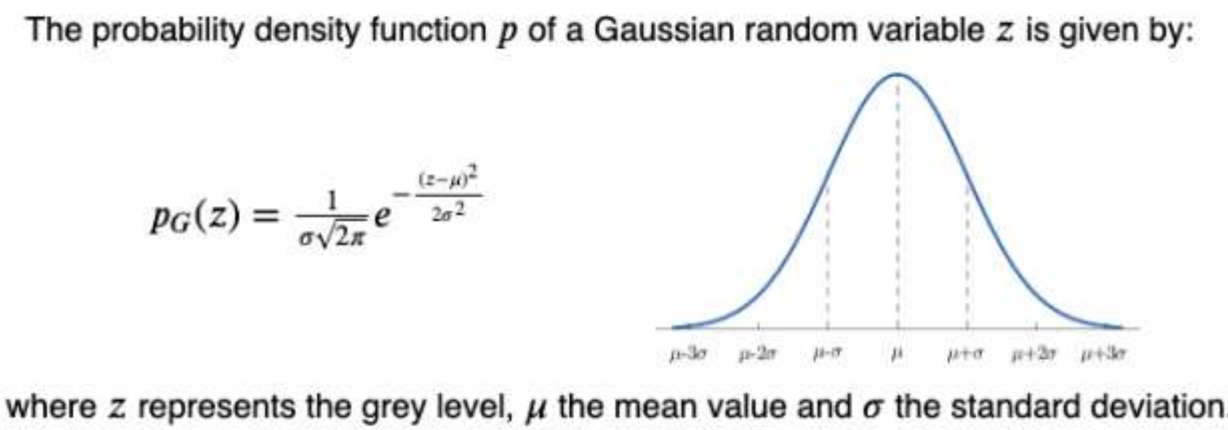

Fig-1: Gaussian Distribution Curve

Data drop-out is another name for salt and pepper noise. It is an Impulse Noise with a fixed value. For an 8-bit image, there are only two potential values for this: 255 (bright) for salt noise and 0 (dark) for pepper noise.
Sources include malfunctioning sensor cells in cameras and rapid, sharp changes in the visual signal.

Shot noise and quantum (photon) noise are other names for poisson noise. This kind of noise has a Poisson distribution-like probability density function.
Source: Random photon fluctuation

Speckle noise is a rough noise that naturally occurs in photographs and degrades their quality. By multiplying random pixel values with various picture pixels, speckle noise can be modelled.

image whitening

The technique preserves image information while attempting to eliminate as much random noise as feasible.We divide the picture denoising filters into two major groups: 1. Traditional Filters - Historically, noise was removed from photographs using these filters. These filters are further broken down into transform and spatial domain filters.
2). Filters that include the idea of fuzzy logic into their filtering process are known as fuzzy based filters.

4 PROPOSED WORK

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MATLAB script that scans an input image and, depending on user input, adds various types of noise (such as salt-and-pepper, Gaussian, or speckle) to the image. The noisy image is then denoised using an artificial neural network (ANN). Finally, it enhances the denoised image using fuzzy c-means clustering and gamma correction and computes several image metrics like PSNR, MSE, NK, and NAE.Understanding the issue this code is attempting to tackle, the efficiency of the techniques employed, and the code's limits are all necessary for a feasibility study. First and foremost, denoising of images is the issue that the code is attempting to fix**.** The method utilised to solve this issue is an ANN, which has been successfully employed to solve a number of image processing issues. However, the efficiency of the ANN for denoising depends on a number of variables, including the calibre of the training data, the network's architecture, the training optimisation algorithm, etc.

As a result, both quantitative and qualitative metrics must be utilised to assess the efficiency of the denoising technique used in the code. Second, the denoised image was enhanced using gamma correction and fuzzy c-means clustering, both of which are common image processing techniques.
These methods can help improve the image's quality, but how well they work relies on a number of different things, including the parameters used and the quality of the incoming image. As a result, both quantitative and qualitative metrics must be used to assess the effectiveness of these strategies.

ADVANTAGES OF PROPOSED SYSTEM:

1. Versatility: The code enables the user to input any image and select from three different noise types (salt-and-pepper, Gaussian, or speckle) to apply while denoising the image. Because of this, it can be applied to a variety of situations.
2. Automated denoising: The code denoises the image using an ANN, which is effective for automating the denoising procedure. The ANN is able to adapt to various sorts of noise because it was trained on a set of photos.
3. The method also use fuzzy c-means clustering to assist in identifying regions of the image that are impacted by noise. Targeting particular regions of the image can enhance the denoising process by making it better.
4. Image metrics: To assess the calibre of the denoised image, the method computes a number of image metrics, including PSNR, MSE, NK, and NAE. This can assist the user in evaluating the success of the denoising procedure and making any necessary parameter adjustments.
5. Visualization: A number of charts in the code display the original image, the noisy image, and the denoised image. This can assist the user in visualising the denoising procedure and assessing the outcomes.

5 METHODOLOGIES

Network of artificial neurons
A system based on the functioning of biological neural networks, or an imitation of a biological brain system, is called an artificial neural network. Why might the use of artificial neural networks be required? Even though today's computers are quite sophisticated, some tasks are still above the capabilities of a programme written for a standard microprocessor. Nevertheless, a software implementation of a neural network can be created, with both benefits and drawbacks.

MODULE 1.
The RGB image is converted to a grayscale image.
MODULE 2
Adds noice to the gray-scale image in.

1. Gaussian Noise: This type of statistical noise has a probability density function (PDF) that is equal to the Normal Distribution.
During image acquisition, sources were used.
For instance, sensor noise brought on by inadequate lighting and/or excessive temperatures.
Throughout Transmission.

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Electronic circuit noise, for instance.

2). Data drop-out is another name for salt and pepper noise.It is an Impulse Noise with a fixed value. For an 8-bit image, there are only two potential values for this: 255 (bright) for salt noise and 0 (dark) for pepper noise.

Sources Sharp and rapid changes in the visual signal; a camera sensor cell that isn't working properly.

3). Shot noise and quantum (photon) noise are other names for poisson noise. This kind of noise has a distribution-based probability density function. Source: Photons fluctuate randomly.

4. Speckle Noise - Speckle noise is an abrasive noise that naturally occurs in photographs and degrades their quality. By multiplying random pixel values with various picture pixels, speckle noise can be modelled.

6 RESULTS AND DISCUSSION SCREENSHOTS

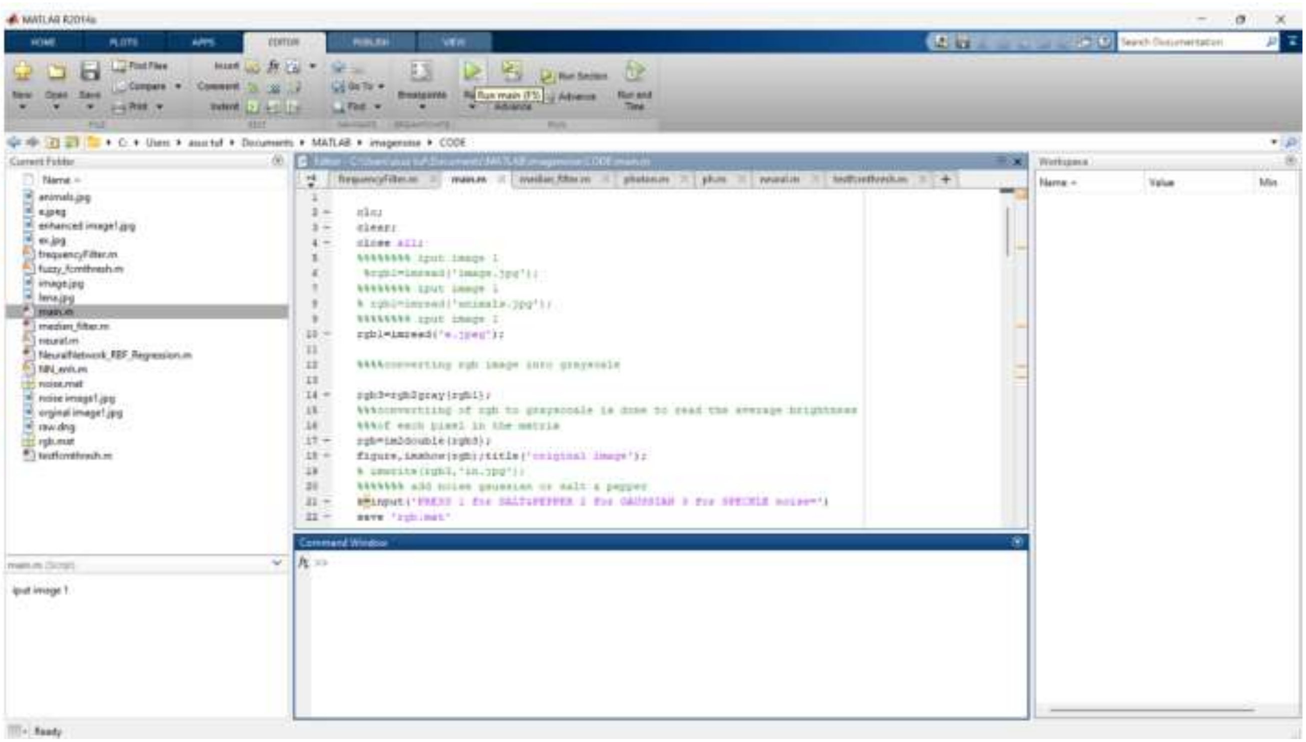

Fig-2: - Represents the UI of the Math Works for running the code

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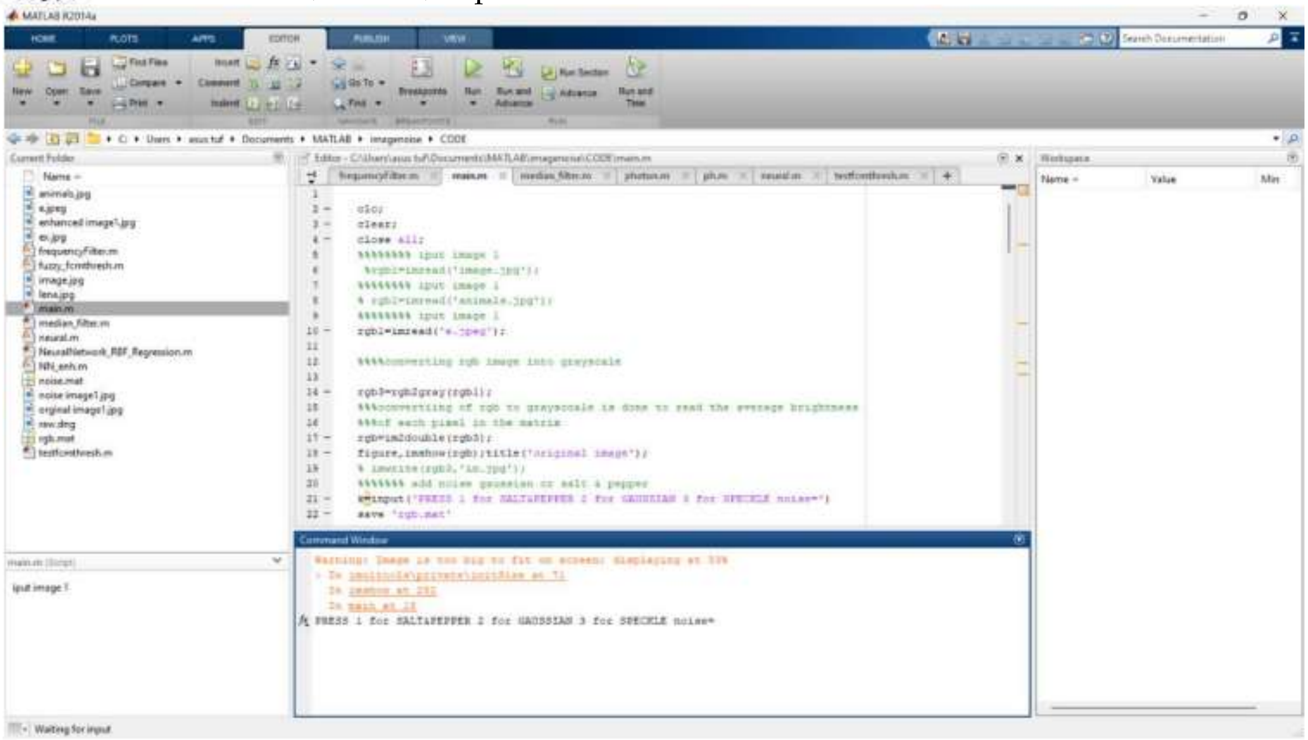

Fig-3: Once the code is set to run it displays the output with three options to apply corresponding noise respectively

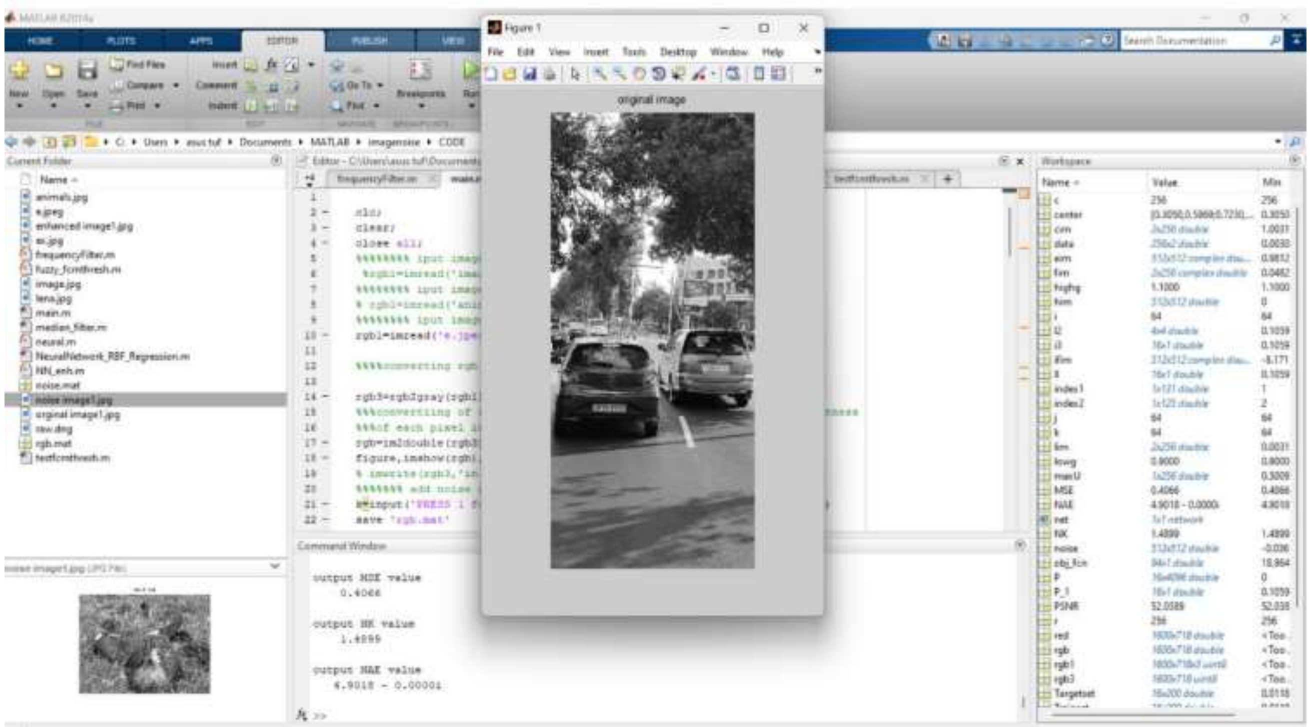

Fig-4: - Display of the original image

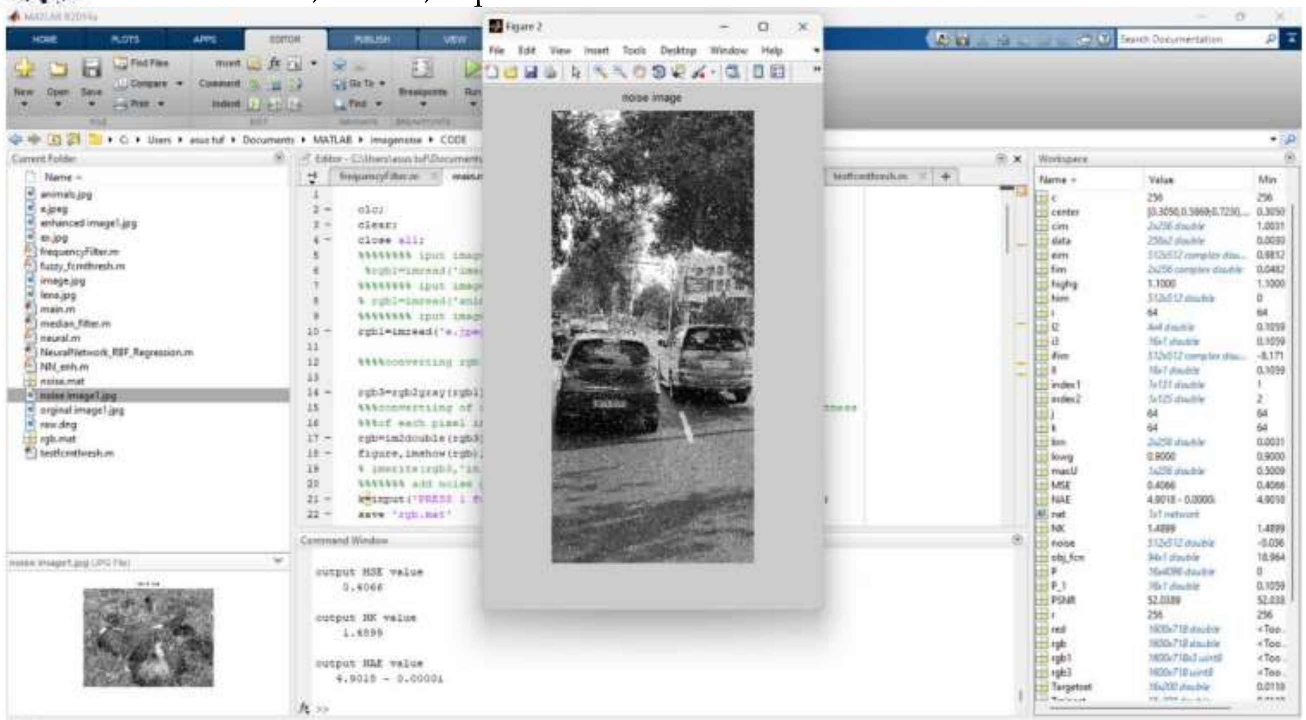

Fig-5: If 1 is selected the Salt and Pepper noise is applied and the image with noise is displayed.

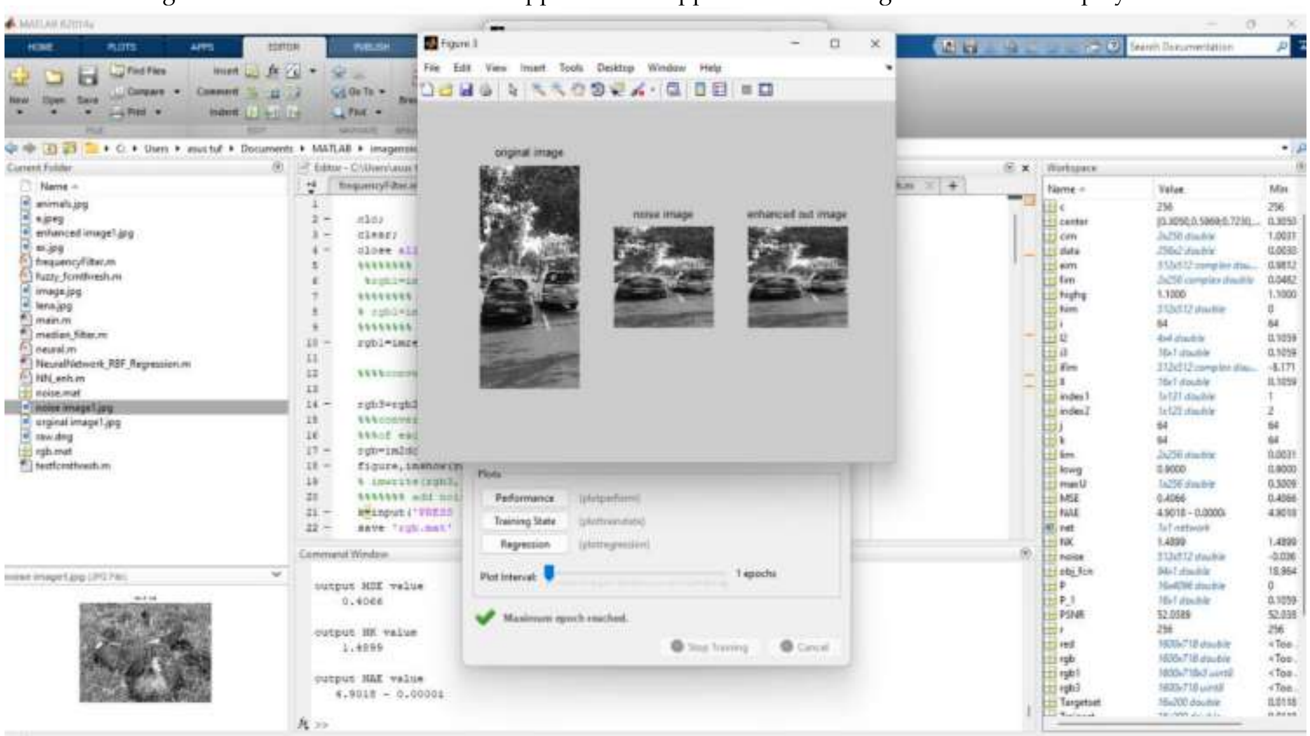

Fig-6 : The final output after denoising the Salt and Pepper noise, the enhanced image is displayed

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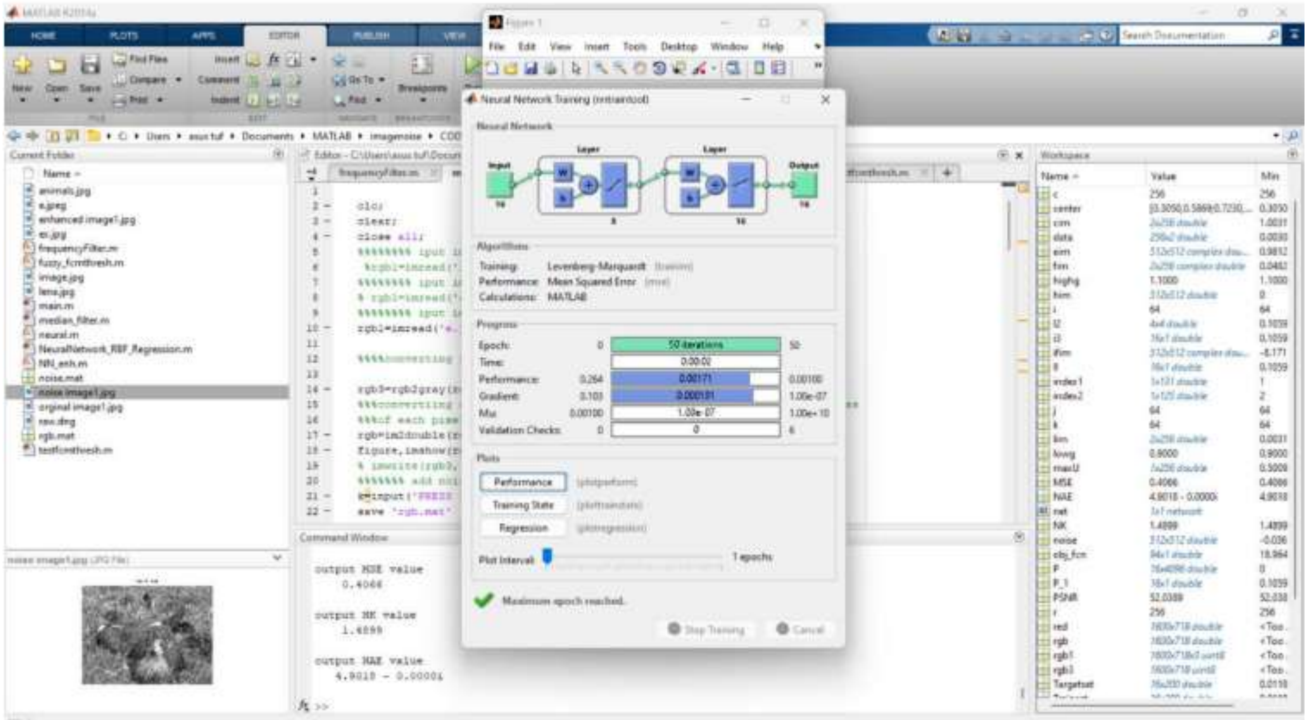

Fig-7 : Finally the quality metrics after the enhancement of the images is displayed

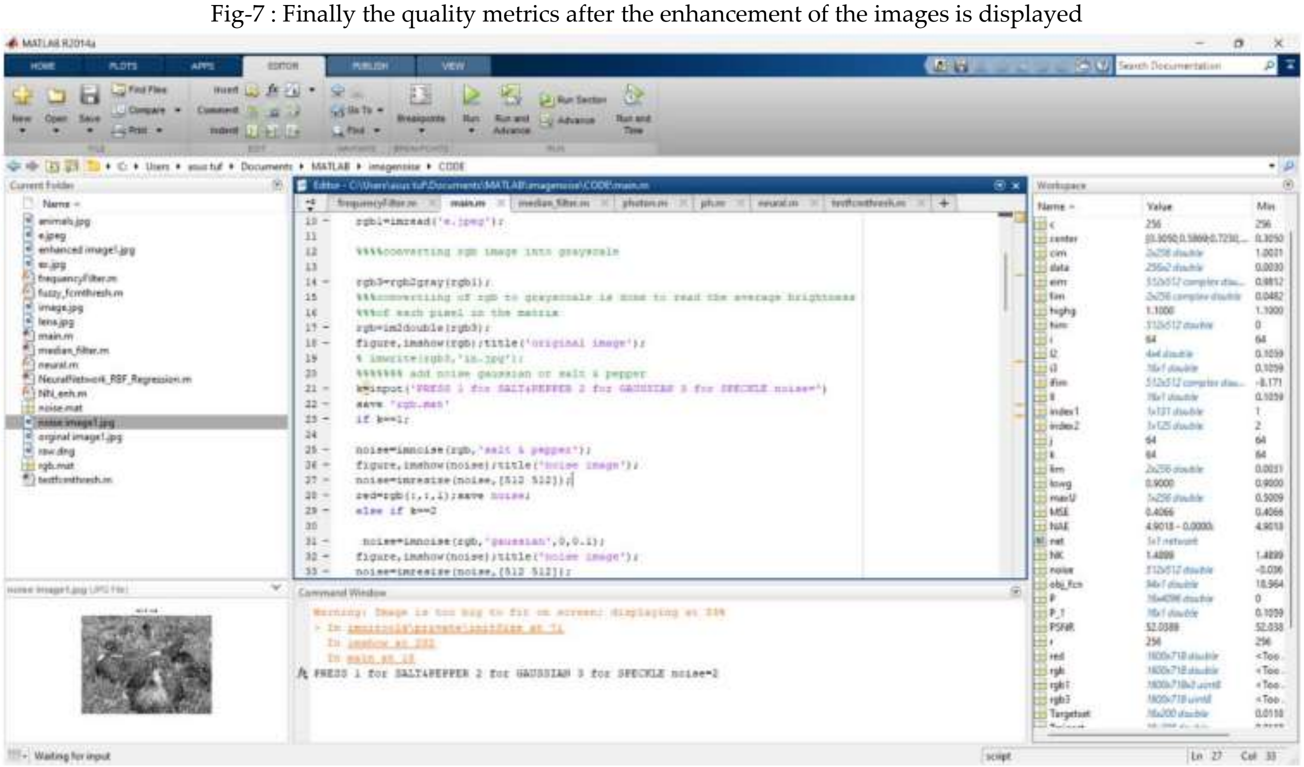

Fig-8 : The Gaussian noise is selected.

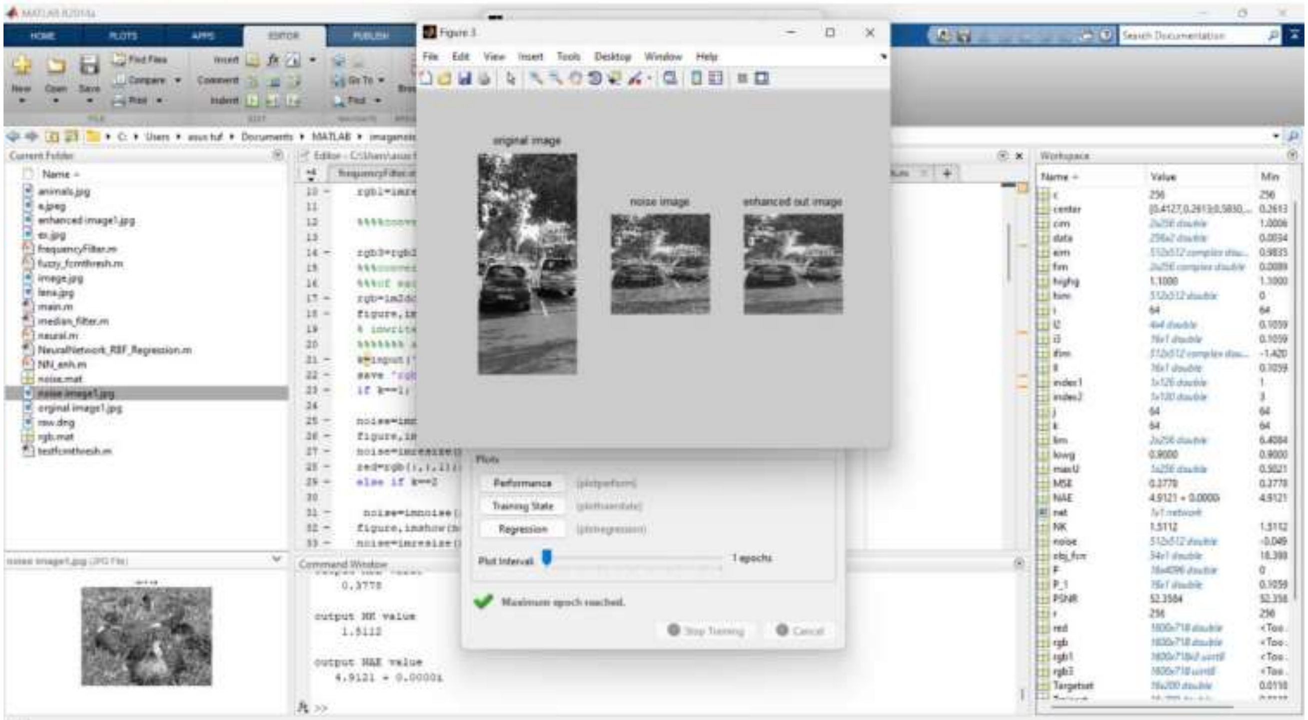

Fig-9 : The final output after denoising the Gaussian, the enhanced image is displayed

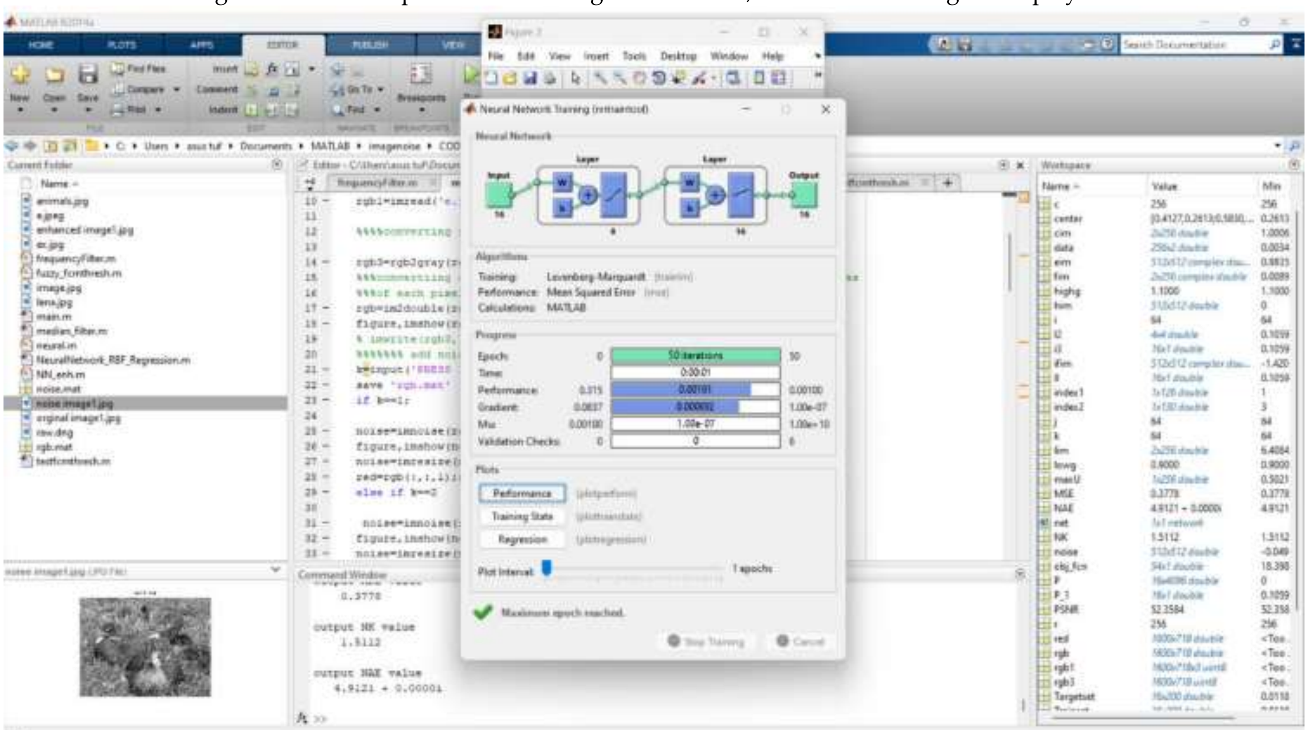

Fig-10 : Finally the quality metrics after the enhancement of the images is displayed

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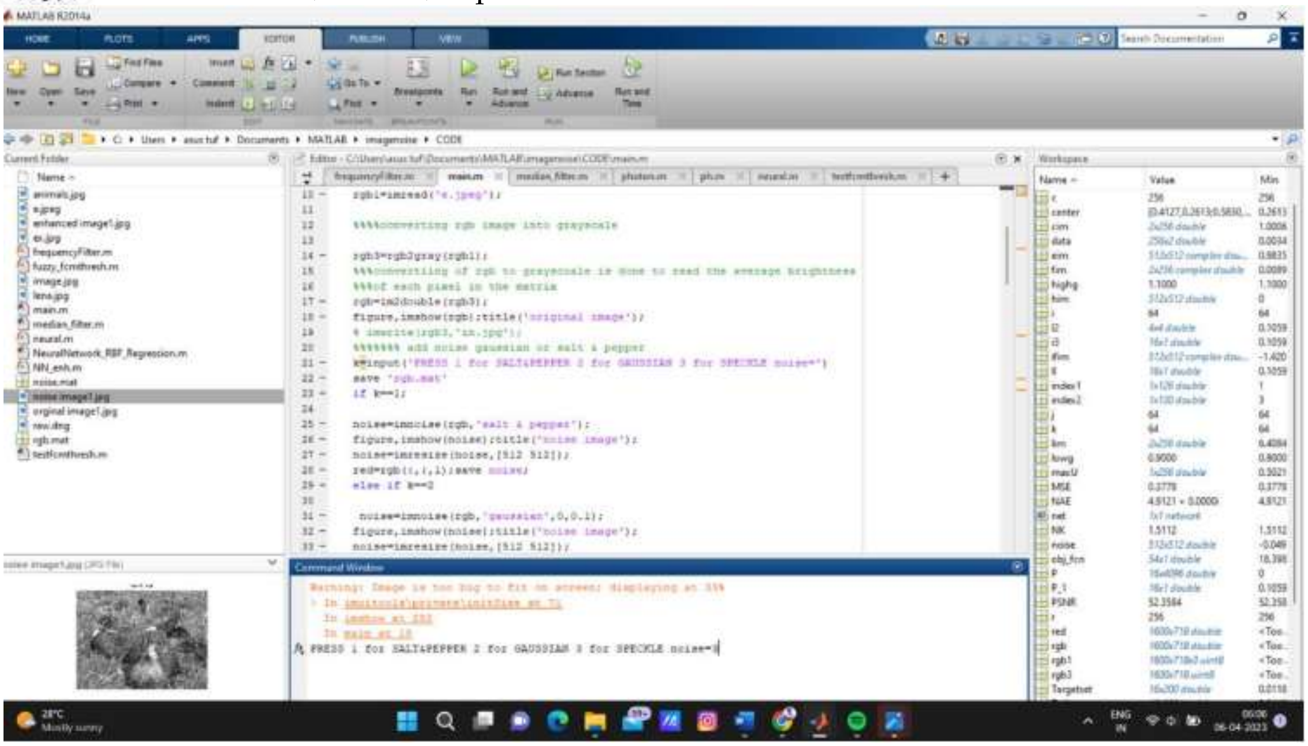

Fig-11 : The Speckle noise is selected

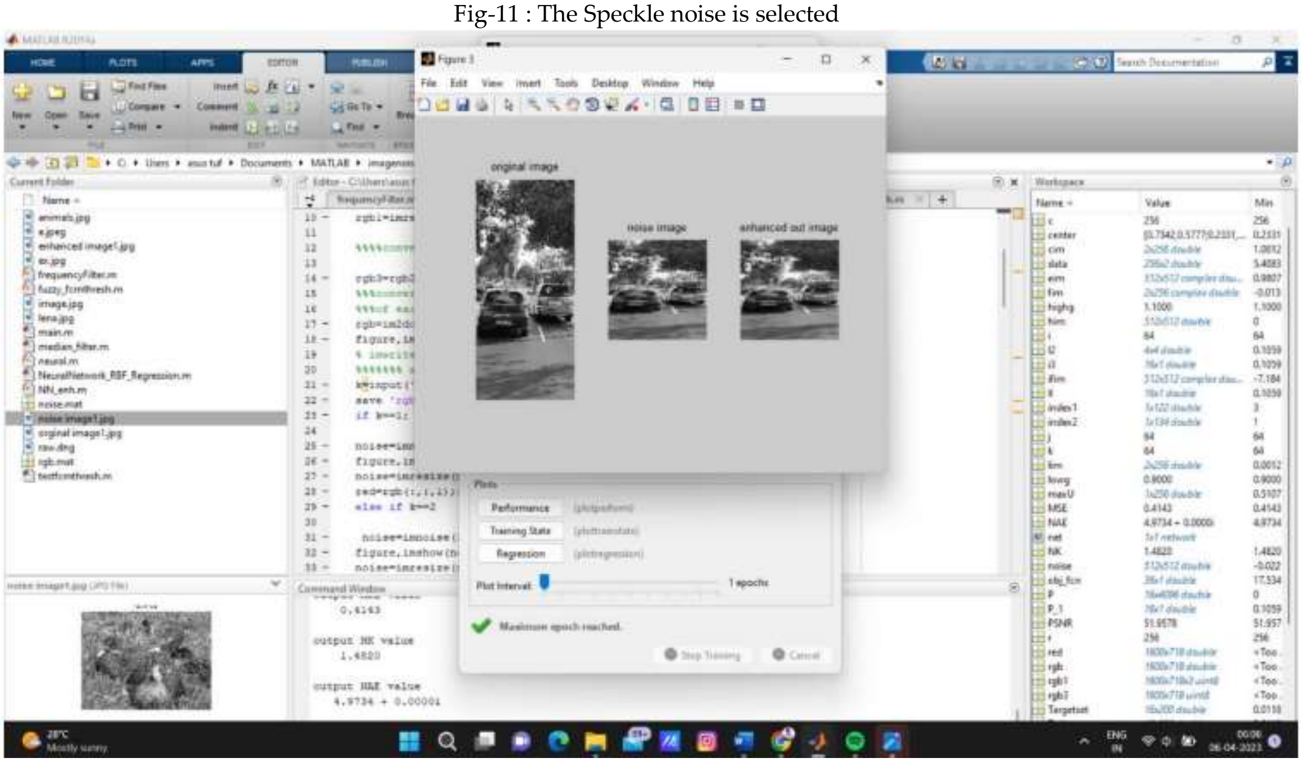

Fig-12 : The final output after denoising the Gaussian, the enhanced image is displayed.

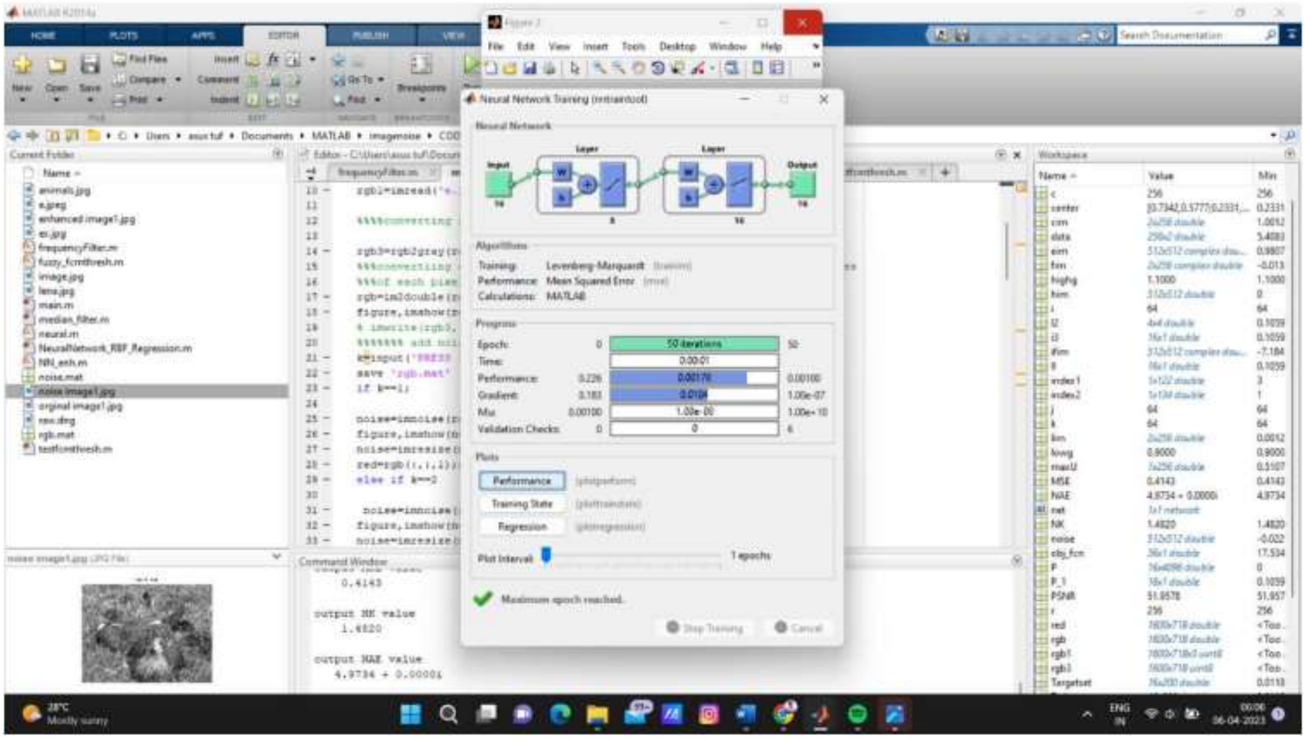

Fig-13 : Finally the quality metrics after the enhancement of the images is displayed.

7. CONCLUSION AND FUTURE WORK

As long as the spatial density of the impulse noise is not too high, the median filter functions effectively. However, impulsive noise can be handled by adaptive median filtering with probabilities considerably higher. The adaptive median filter also aims to maintain detail while reducing nonimpulse noise, which is a further advantage. The adaptive method did fairly well given the high level of noise. The application will determine the maximum permissible window size, but testing with different sizes of the conventional median filter can give you a good idea of where to start. Although it appears that it won't handle some unusual situations when a single parameter is sufficient for the choice, it is highly effective and trustworthy in some situations.

This will create a visible benchmark for expectations of how well the adaptive algorithm will perform. This study will be done to improve future picture improvement and make it feasible to denoise photographs with diverse noises using effective quality criteria.

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