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A secure, reversible data hiding and plaintext encryption for medical images

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Abstract:

In this proposed work, Visual Secret Sharing improves security, and the data is then combined to achieve secure transmission and image quality. The cover image is processed using the DWT and Cuckoo algorithms first. On the other hand, Visual Secret Sharing uses a secret image. The visual secret sharing image is paired with a processed cover image utilising the Jsteg method for data embedding and extraction. Image quality was assessed using performance analysis techniques such as MSE, PSNR, and hiding capacity on various types of colour photographs, and the results were compared. The results show that the suggested approach is adaptive, with low mistakes and a high SNR rate at different data hiding capacities.

Key Words: DWT, Cuckoo algorithm, image processing, Jsteg method, MSE, PSNR, and hiding capacity

I. INTRODUCTION

In today's technology security is a major concern. Every day a slew of new recommended techniques are produced to address difficulties in numerous fields. Still, in the field of health, security is critical to provide privacy and security for patient records in order to avoid data hacking and data surfing in hospital databases. For example, A patient MRI scan e picture report can be stored in a database to increase the security of biomedical images for the patient's benefit, confidentiality, and privacy. Without consent from both the patient and the doctor, hospital employees should not be allowed to see them directly. Any intruder attempting to view the report will be unable to do so since it is in the form of a hidden state in another image. A patient's MRI scan image should be pre-processed and then converted into steganography technique in the form of two things. The first is in image form, and the second is in text form. Each time an MRI image is transformed into text or picture form. The photos should then be encrypted using the proposed cryptography algorithm and saved in the database. Cryptography algorithms transform such unknown forms into another form for the goal of security, privacy, and authentication for the patient as well as a hospital for high quality of service. Image processing is now the most significant area in computer science. Computer equipment and programmes produced in response to technological advances have reorganised image-related efficiency and drawn more substantial concerns on these issues. Furthermore, researchers have been researching on ways to apply picture recognition algorithms in everyday life. Image processing technology has provided advantages and innovations in the domains of research, industry, security, and health. The majority of medical pictures have a lower noise-to-signal ratio than scenes captured with a digital camera, which frequently results in a lower spatial resolution that permits the difference between things that are distinct physically but too low to be correctly computed. For example, Speckle noise which is generated by the scrambling of ultrasonic signals from tissue inhomogeneities in the microscope, can blanket the region of low contrast lesions in ultrasonic pictures, reducing the capacity of a human observer to figure out the solution of last information. Nuclear medicine photos depict a similar situation. Picture preprocessing techniques used for medical image blur and noise reduction are critical in light of these issues. Second, modifications to the meaning o f a picture must be made in a very precise and regulated way that does not jeopardise clinical decision-making. Although cleaning away locally bright noise patches is generally sufficient, mammography must be prioritised above evacuation of microcalcifications. In magnetic resonance imaging, however, inhomogeneity in the magnetic field results in an effect of intensity non-uniformity. This common artefact appears as a smooth, steady shift in the values of an image's pixels. It may have a detrimental impact on the deployment of approaches that rely on automatic segmentation and strength. Third, information gleaned from two pictures taken in the clinical course of events is frequently complimentary. It is possible that a real combination of relevant data collected from the individual pictures is required.

II. ITERATURE SURVEY

A. Lukáš krasula, miloš klíma, eric rogard, edouard jeanblanc, **"MATLAB-BASED APPLICATIONS FOR IMAGE PROCESSING AND IMAGE QUALITY ASSESSMENT – PART I: SOFTWARE DESCRIPTION."**

Several MATLAB-based applications are useful for image processing and picture quality assessment was defined by Luká Krasula, Milo Klma, Eric Rogard, and Edouard Jeanblanc. The Image Processing Application makes it simple for users to edit images. The Image Quality Adjustment Application allows users to create a series of photos of varying quality. The Image Quality Assessment Application includes objective full-reference quality criteria for assessing image quality. A simple tool for comparing the subjective quality of blurred images to a reference image is included in the Image Quality Evaluation Applications. The Results Processing Application can be used to process the results of these tests. All programmes include a graphical user interface (GUI) for easy navigation.

B. Zhenghao Shi, Lifeng He**, "CURRENT STATUS AND FUTURE POTENTIAL OF NEURAL NETWORKS USED FOR MEDICAL IMAGE PROCESSING."**

Lifeng and Zhenghao Shi He classifies neural networks based on their processing goals and the presence of medical pictures. The first was on-the-job testing, which allowed neural networks to be employed in development situations. The author elaborated When a neural network is trained to identify patterns gathered from one set with a certain class, the neural network's output may be weaker and likely unacceptable when transferred to a novel context with a different class distribution. On-the-job training could be a significant improvement over present systems, allowing for a transferability approach between different medical imaging patterns. The author also explains using emergent novel neural network methods in medical image processing, such as artificial neural network ensembles, neural network-intelligent agent combinations, genetic algorithms with fuzzy fitness and neural networks, and so on, represents a promising alternative for improving the effectiveness of medical image processing.

C. Hamdan Lateef Jaheel and Zou Beiji**, "A NOVEL APPROACH OF COMBINING STEGANOGRAPHY ALGORITHMS."**

Steganography, which is the act of hiding a message inside another message such that only the receiver can recognise the hidden message was developed by Hamdan Lateef Jaheel and Zou Beiji. They integrated two Steganography methods, JSteg and OutGuess. They used two algorithms to improve the level of security for secret photos by using the favourable traits and features of both techniques. Their method was the first to use the JSteg algorithm to hide a secret image inside another image. In this approach, Already hidden communications were using two separate methods, which increases the complexity for third-party users to detect the existence of a secret image in the first place, let alone decode it effectively. The emphasis in this strategy was placed on selecting a decent picture size and kind, which further disguises the secret image and enhances the likelihood that the image will go undiscovered. After calculating the data, the capacity and PSNR for images demonstrated that their approach was a good and acceptable steganography system. The model shown here was created using JPEG pictures.

D. Neha Solanki, Sanjay Kumar Malik, Sonam Chhikara**, "RONI MEDICAL IMAGE WATERMARKING USING DWT AND RSA."**

Neha Solanki, Sanjay Kumar Malik, and Sonam Chhikara show how to save patient data in a medical image, such as a CT scan or an MRI image. They divided the project into two key stages. The initial step was to calculate the ROI and RONI of the image. In this case, ROI was defined as the information portion of the medical picture, whereas RONI was defined as the non-information portion of the MRI image. It will prevent the user from destroying the useful material of the image. The watermark was encrypted with RSA. The second was on the verge of hiding the image in RONI. A DWT-based approach was utilised to conceal such detail.

E. Rahul Saxena, Nirupma Tiwari, Manoj Kumar Ramaiya**, "BLIND DIGITAL WATERMARKING USING AES TECHNIQUE FOR COLOR IMAGES."**

Copyright protection is drawing and expanding attention these days since digital multimedia content such as text, image, audio, and video are widely utilised and easily distributed via the internet. In addition to copyright protection, digital watermarking is employed for digital marketing and advertising services. To improve security Rahul Saxena, Nirupma Tiwari, and Manoj Kumar Ramaiya presented authentic and copyright a Blind digital watermarking utilising AES algorithm for colour photos. This technology improves the confidentiality of secret information sent while eliminating visual distortion. MATLAB was used to run the simulations. The total PSNR was enhanced by employing the Advanced Encryption Standard (AES) method and noise filters.

F. Muley Jayant Arun, Dr. S G Kejgir**, "NEW ROBUST DIGITAL IMAGE WATERMARKING USING DWT, DCT, AND SVD."**

Dr. S G Kejgir and Muley Jayant Arun presented a robust digital image watermarking algorithm based on DWT, DCT, and SVD domain coefficients. To improve the algorithm's robustness, the discrete wavelet transform (DWT) was utilised. Only the low-frequency coefficients (LL band) of DWT were converted into a frequency domain using DCT. The watermark image was inserted in a single diagonal matrix of SVD decomposition of LL band DCT frequency representation. Because the method does not change any pixel information in the cover picture, it has no effect on its quality. This was a blind watermarking algorithm. The adoption of a unique similarity key method increased security. According to the results, this method is immune to compression, noise, and geometric assaults. They were able to demonstrate their inspiration for picture authentication by evaluating the correlation coefficient between embedded data and derived data.

III. PROPOSED SYSTEM

VSS (Visual Secret Sharing) based on half-toning with DWT, Cuckoo Search, and Jsteg. Get any image/frame format (Input Cover Image) from the current working directory or the chosen directory. First, locate the hidden picture in a directory. Then read the secret image; if you don't read the image, don't proceed to the next stage. The input image can be changed to greyscale once it has been read. The VSS is then applied using the Halftoning method, yielding the Combined Share picture (share1&2). The embedding (JSteg) method is used to integrate the results from steps 1 and 2 to produce the embedded picture. The embedded picture is maintained after data embedding for encoding. This encoding is used to transmit data. The recovered picture and message image are then extracted using the de-embedding technique. Decrypt the message picture to obtain the actual message image. The major advantage of using encryption in a compression process is that it decreases the size of a picture without losing information if lossless compression is used. However, When a small amount of distortion is acceptable lossy compression can be utilised. The unexpected user who may try to overhear this discussion can either tamper with it to modify its original meaning or listen to it with the intention of decoding it to use to his/her advantage.

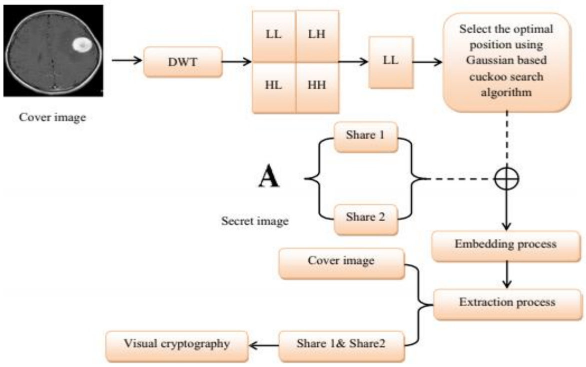

Fig-1: *Proposed system*

IV. IMPLEMENTATION

A. RUN THE CODE

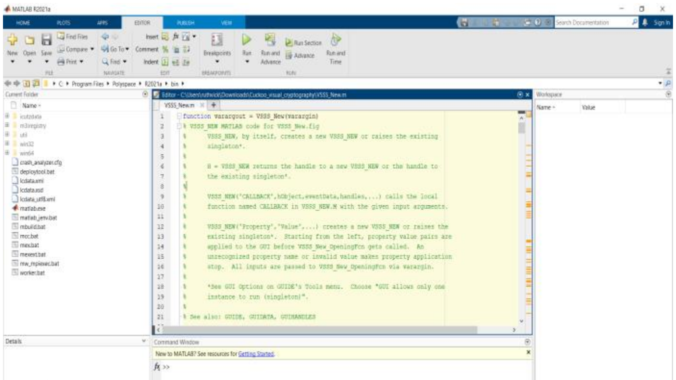

Fig-2: *Before running code*

After running the code we get user interface for image hiding.

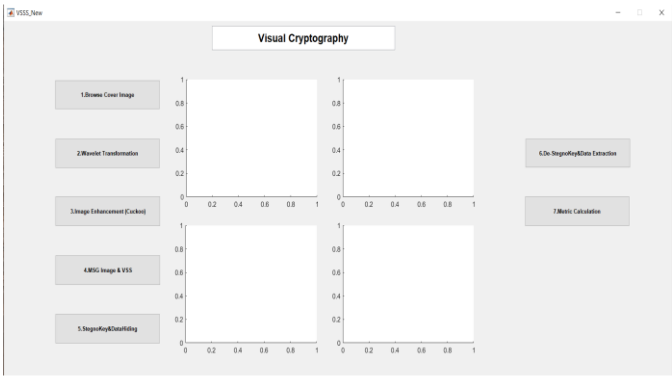

Fig-3: *After running code*

B. BROWSE COVER IMAGE

At first, we need to select any format of image/ frame (Input Cover Image) from the selected directory or current working directory.

Fig-4: *Browse cover image*

After getting the input image from directory. Then read the input image, if not read the image didn't go to another steps. If read then, go to next step (Wavelet Transformation)

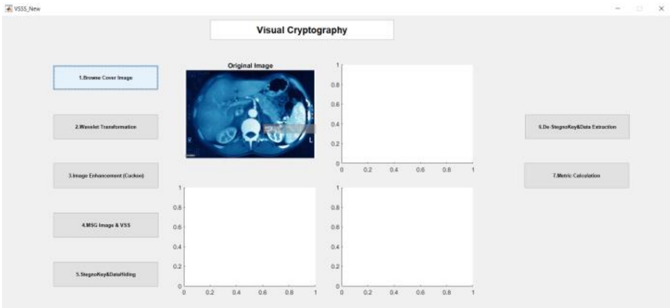

Fig-5: *After browsing cover image*

C. WAVELET TRANSFORMATION

After reading the input image, it may convert into Gray Scale from. Then calculate the intensity values for input image in Gray Scale form. After that Gray Scale image is applied to DWT, and we get Approximation, horizontal, vertical, detail coefficients. In these Approximation coefficients only having complete information of the image.

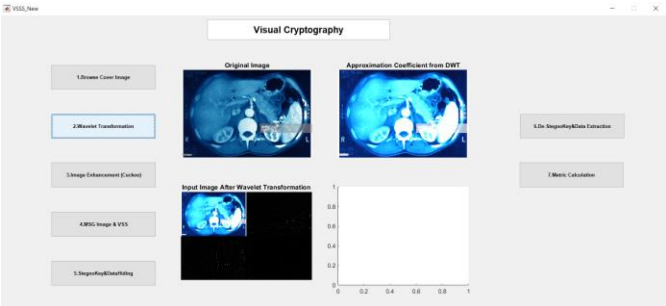

Fig-6: *Using wavelet transformation on selected cover image*

Further call the cuckoo search algorithm for image enhancement.

D. IMAGE ENHANCEMENT (CUCKOO)

After reading the input image and applying Wavelet transformation, we are going for Image Enhancement by using Cuckoo search algorithm. Then, we will get Enhanced image in Gray scale and RGB (Red, Green, Blue).

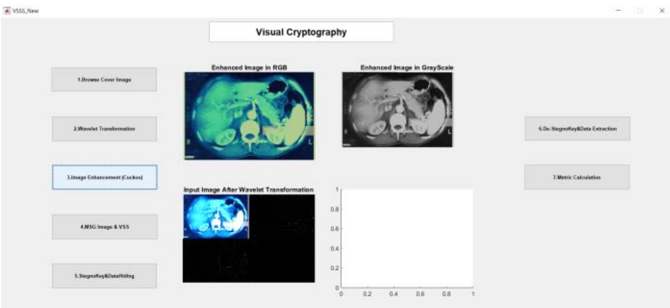

Fig-7: *Using cuckoo algorithm to enhance image*

We will also get the Convergence plot (fmin vs no. of iterations) for Enhanced Image in RGB. Figure 1 shows the Convergence plot for the Red colour. Figure 2 shows the Convergence plot for the Green colour. Figure 3 shows the Convergence plot for the Blue colour.

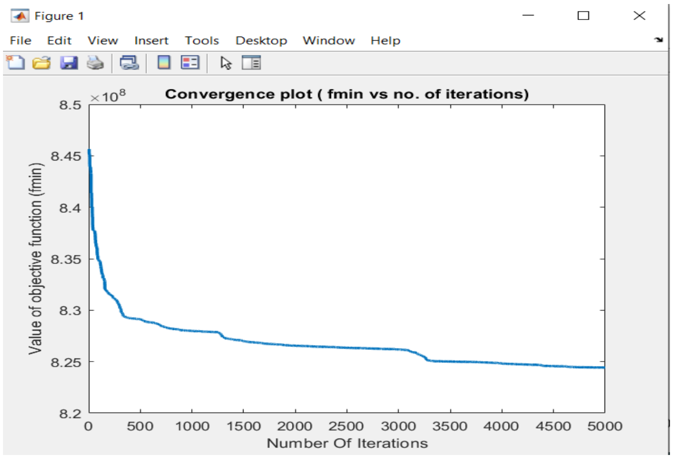

Fig-8: *Convergence plot*

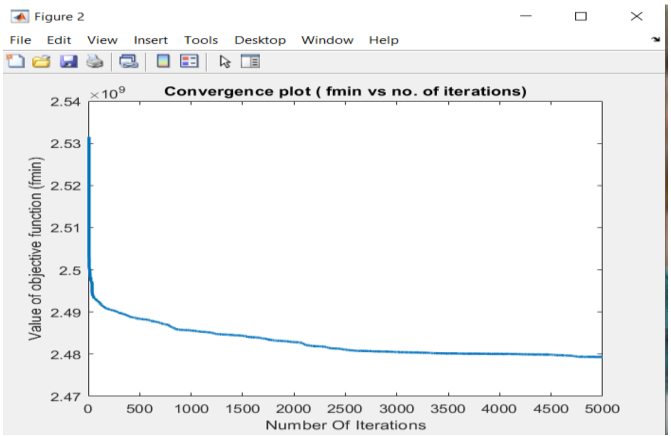

Fig-9: *Convergence plot*

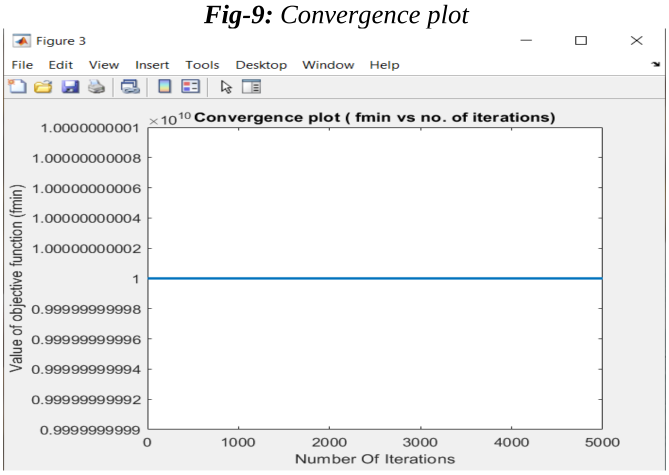

Fig-10: *Convergence plot*

And then go to next step Message image and VSS (Visual Secret Sharing)

E. MSG IMAGE & VSS

Secondly select any format of image/ frame (Secret/ Message image) from the selected directory or current working directory.

Fig-11: *Selecting secret image*

After the getting the secret image from directory. Then read the secret image, if not read the image didn't go to another steps.

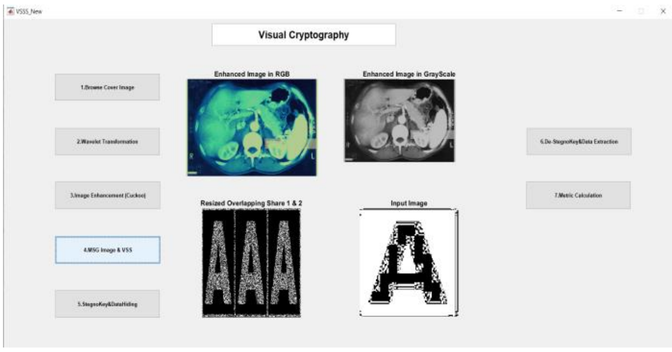

Fig-12: *After selecting secret image*

Then apply the VSS by halftoning process. And we get the Combined Share image (share1&2).

Fig-13: *Share1 & Share 2 secret images*

F. STEGNOKEY&DATAHIDING

From stage 1 &2 outputs are combined by embedding (Jsteg) method, to get the embedded image. For that embedding process (Data Hiding) the StegnoKey is used.

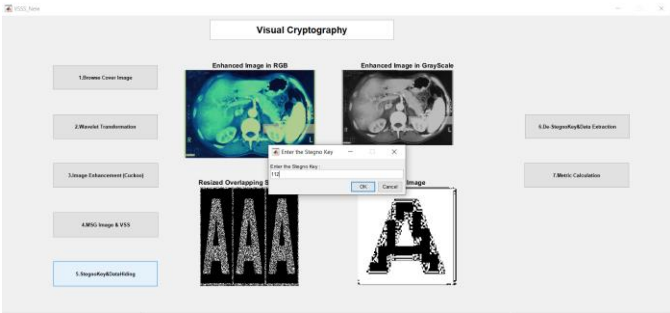

Fig-14: *Using stegnokey*

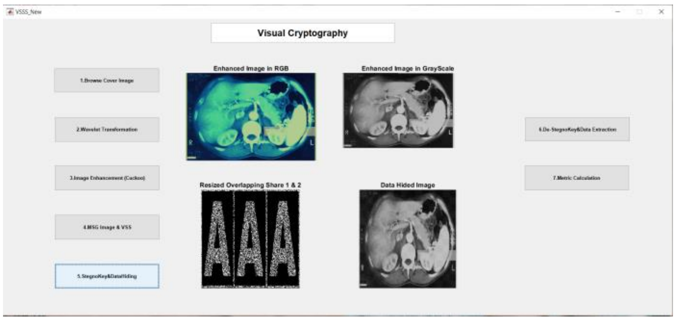

Fig-15: *After using stegnokey*

After the data embedding, embedded image is kept for encoding. This encoding is used for data transmission.

G. DE-STEGNOEY&DATA EXTRACTION

Then applies to de-embedding scheme to get the recovered image and message image separately. For that de-embedding process (Data Extraction) the De-StegnoKey is Used.

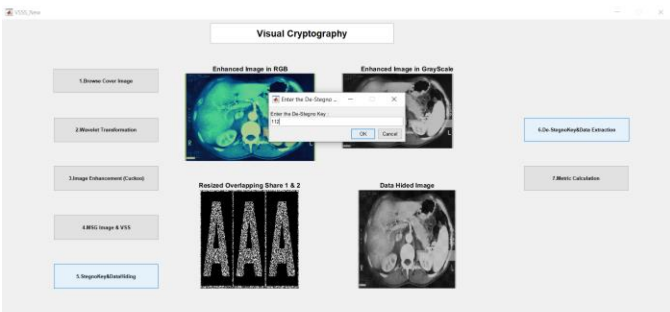

Fig-16: *Using De-stegnokey*

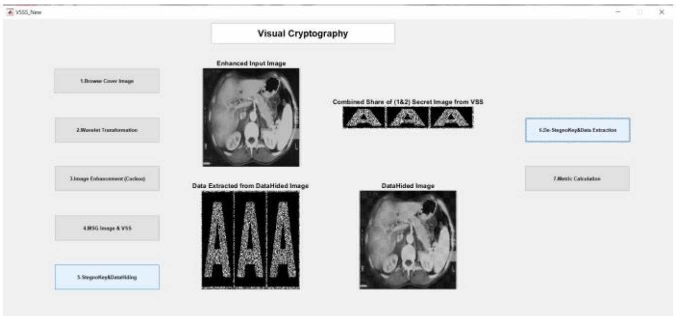

***Fig-17:** After using de-stegnokey*

After that, decrypt the message image, to get the exact message image.

H. METRIC CALCULATION

Finally, the Metric calculation is used to get the gradient image for Jsteg (Figure 1 & Figure 2).

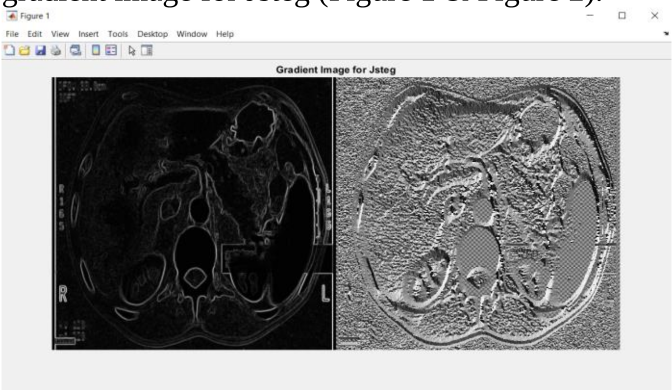

***Fig-18:** Gradient image*

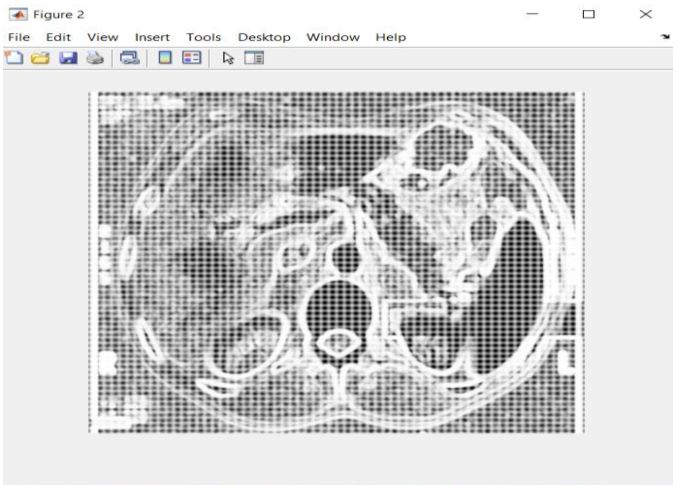

***Fig-19:** Gradient image*

V. CONCLUSIONS

A novel visual secret sharing technique for medical pictures combining Cuckoo search and the Jsteg method. MATLAB is used to implement our technique. The efficacy of the suggested technique is assessed using several assessment measures such as PSNR, Normalized correlation, and MSE value. Our suggested technique was assessed using these measures, and the results were compared to other existing methods. This work is confined to pictures of brain tumours. It may also be used to a variety of other biological image processing applications, such as pictures of lung cancer.

REFERENCES

[1] Lukáš Krasula, Miloš Klíma, Eric Rogard, Edouard Jeanblanc "MATLAB-based Applications for Image Processing and Image Quality Assessment – Part I: Software Description" radio engineering, vol. 20, no. 4, December 2011

[2] Zhenghao Shi, Lifeng He, "Current Status and Future Potential of Neural Networks Used for Medical Image Processing," Journal of Multimedia, Vol. 6, No. 3, June 2011.

[3] Hamdan Lateef Jaheel and Zou Beiji, "A novel approach of combining steganography algorithms," Proceedings of international journal on smart sensing and intelligent systems vol. 8, no. 1, March 2015.

[4] Neha Solanki, Sanjay Kumar Malik, Sonam Chhikara, "RONI Medical Image Watermarking using DWT and RSA", Proceedings of the international journal of computer applications (0975 – 8887) volume 96– no.9, June 2014.

[5] Rahul Saxena, Nirupma Tiwari, Manoj Kumar Ramaiya, "Blind digital watermarking using AES technique for color images", Proceedings of International Journal of Emerging Technologies in Computational and Applied Sciences, 11(1), December-February, 2015, pp. 54-57.

[6] Muley Jayant Arun, Dr. S G Kejgir, "New Robust Digital Image Watermarking using DWT, DCT and SVD", Proceedings of International Journal of Engineering Research & Technology (IJERT)ISSN: 2278-0181, Vol. 3 Issue 7, July – 2014.

[7] S. Sivasankari, S. R. Sophiya," MATLAB Implementation of Invisible Watermarking using LSB and Lifting Wavelet Transform Technique", Proceedings of the international journal of scientific engineering and technology research, April 2014 vol 3issue 4.

[8] E.Sangeetha Devi, "Enhanced Visual Secret Sharing Scheme via Halftoning Technique", Proceedings of 2010 INTERNATIONAL CONFERENCE ON COMMUNICATION CONTROL AND COMPUTING TECHNOLOGIES. doi:10.1109/iccct.2010.5670739

[9] Suchethana H C, "visual cryptography and its challenges", Proceedings of International Journal of Computer Engineering and Applications, Volume XII, Issue III, March 18, www.ijcea.com ISSN 2321-3469

[10] Stelvio Cimato, Roberto De Prisco and Alfredo De Santis. "Colored visual cryptography without color darkening". Theoret. Comput. Sci. 374(1–3), 261–276 (2007)

[11] Stelvio Cimato, Alfredo De Santis, Anna Lisa Ferrara, and Barbara Masucci, " Ideal contrast visual cryptography schemes with reversing." Inf. Process. Lett. 93(4), 199–206 (2005)

[12] Roberto De Prisco and Alfredo De Santis, " Color visual cryptography schemes for black and white secret images." Theoret. Comput. Sci. 510(28), 62–86 (2013)

[13] Roberto De Prisco and Alfredo De Santis, "On the relation of the random grid and deterministic visual cryptography". IEEE Trans. Inf. Forensics Secure. 9(4), 653–665 (2014)

[14] Chih-Ming Hu and Wen-Guey "Cheating prevention in visual cryptography." IEEE Trans. Image Process. 16(1), 36–45 (2007)

[15] Gwoboa Horng, Tzungher Chen And Du-Shiau Tsai "Cheating in visual cryptography." Des. Codes Crypt. 38(2), 219–236 (2006)

[16] Kai-Hui Lee and Pei-Ling Chiu."An extended visual cryptography algorithm for general access structures." EEE Trans. Inf. Forensics Secure. 7(1), 219–229 (2012)

[17] P. Tuyls, H. D. L. Hollmann, J. H. Van Lint, And L. Tolhuizen "XOR-based visual cryptography schemes." Des. Codes Crypt. 27, 169–186 (2005)

[18] Tjokorda Agung B. W, Adiwijaya, and Fri Puguh Permana, "Medical Image Watermarking with Tamper Detection and Recovery Using Reversible Watermarking with LSB Modification and Run Length Encoding (RLE) Compression", in proceedings of 28th Annual International Conference of the IEEE, New York, USA, vol. 30 pp. 3270-3273, 2010.

[19] Chunhua Dong, Jingbing Li, Mengxing Huang, and Yong Bai, "The Watermarking Medical Image Algorithm with Encryption by DCT and Logistic" in proceedings of Ninth Web Information Systems and Applications Conference, vol. 6072, San Jose, CA, pp. 1-13, 2012.

[20] Jingbing Li and Yaoli Liu "The Medical Image Watermarking Algorithm Using DWT-DCT and Logistic", in proceedings of IEEE Ninth Web Information Systems and Applications Conference, vol. 30, pp. 119-124, 2012

.

[21] G. Prabakaran, Rajeswari P Sand R. Bhavani, "Multi Secure and Robustness for Medical Image Based Steganography Scheme", in proceedings of 2013 IEEE International Conference on Circuits, Power and Computing Technologies, vol. 28, pp. 947-951, 2013.

[22] Nisar Ahmed Memon, S.A.M. Gilani, Shams Qayoom, "Multiple Watermarking of Medical Images for Content Authentication and Recovery", in Proceedings of World Academy of Science, Engineering and Technology, vol. 38, pp. 347-350, 2009.

[23] Siau-Chuin Liew and Jasni Mohamad Zain, "Reversible Medical Image Watermarking For Tamper Detection and Recovery", Computerized Medical Imaging and Graphics, 2003, vol. 27, pp. l85-196, 2010.