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A Comprehensive & Investigative Review of Literature on Digital Image Processing Technique for Multidisciplinary Industrial Application

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Abstract: In the era of digital communication, digital image play a vital role in most of industrial and corporate forensic applications. Digital imaging has experienced extraordinary revolution in recent decades, and digital images have been used in a growing number of applications. Digital Images are used as authenticated proof for any crime and if these images do not remain genuine then it will create question on the authentication process. Detecting these types of forgeries has become serious issue. To determine whether a digital image is original or doctored is a big challenge. The detection of image tampering in a digital image is a challenging task. This paper presents a literature survey on some of the image Manipulation detection techniques such as image pre-processing, image compression, edge detection, segmentation, contrast enhancement detection, splicing and composition detection, image tampering and more. Comparison of all the techniques concludes the better approach for its future research.

Keywords: Digital Forensics, Digital Image Processing, Image Manipulation, Contrast Enhancement

I. INTRODUCTION

Image processing is image manipulation technique in which the image is processed by adding or removing some elements from the image which results in a better quality of image for advance application. Image processing is frequently used in numbers of industrial and corporate applications [1] in recent period. Authentication application, matching application, image recognition, forensic investigation and image forgeries are the areas where researchers are needed image processing technique. With the increasing applications of digital imaging, different types of software are introduced for image processing. Such software can do an alteration in digital image by changing blocks of an image without showing the effect of the modification in the forged image. These modifications cannot be noticed by human eyes. Therefore verification of originality of images has become a challenging task. An image can be manipulated with a wide variety of manipulation techniques such as scaling, rotation, blurring, re-sampling, filtering, cropping, etc. Image forgery detection technique is needed in many fields for protecting copyright [2] and preventing forgery. Generally, image manipulations could be classified into (1) Content-Changing Manipulations (2) Content-Preserving Manipulations.

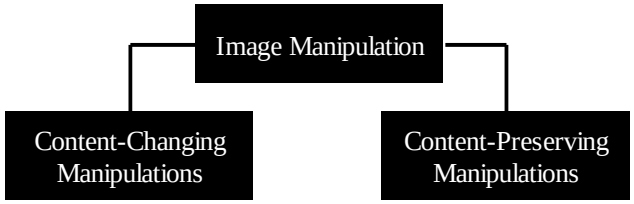

Figure-1 Image Manipulation Technique

The verification of originality of images is required in variety of applications such as military, forensic, media, scientific, glamour, etc. Image tampering is a digital art which needs understanding of image properties and good visual creativity. Detection of image tampering deals with investigation on tampered images for possible correlations embedded due to tampering operations. Detecting forgery in digital images is a rising research field with important implications for ensuring the credibility of digital images. With the rapid development of digital media editing techniques, digital image manipulation becomes rather convenient and easy. While it benefits to legal image processing, malicious users might use such innocent manipulations to tamper digital photograph images. Currently, image forgeries are widespread on the Internet and other security-related applications such as surveillance and recognition that utilize images are therefore impacted. The event and scene information delivered in images might become no longer believable. In the applications such as law enforcement and news recording, it is also necessary to

verify the originality and authenticity of digital images, and make clear the image manipulation history to get more information. To circumvent such a problem, digital forensic [3] techniques have been proposed to blindly verify the integrity and authenticity of digital images.

Accordingly, prior works on image manipulation forensics fall into two categories. As the first category, the forensics methods focus on detecting image tampering such as copy – move and splicing, by which the image content is reshaped arbitrarily according to semantic content. In the second category, common manipulations, as compression, blur and contrast enhancement is detected passively. These content-preserving manipulations are often applied as post processing to conceal the residual trail of malicious tampering operations and create realistic forgeries.

The phenomenon of image forgery leads to serious consequences such as reducing trustworthiness and creating false beliefs in many real-world applications.

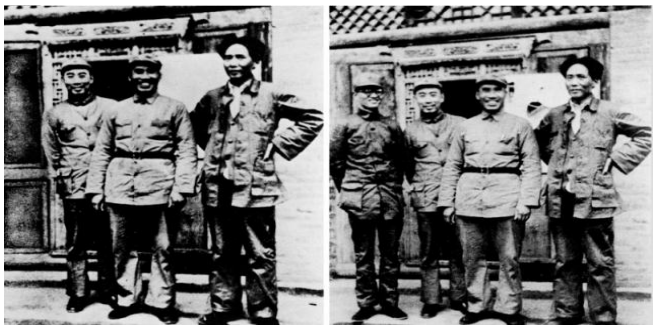

Figure- 2. Historical Example of Doctored Photograph

For example, figure-2 shows a doctored photograph of citizen Cher and Brad Pitt, falsely implying their simultaneous presence at the same location [5]. Figure-3 shows a copied-and-pasted British soldier pointing his machine gun at Iraqi people. It was published on the front page of L.A. Times in 2003, causing the public image of the British Army to be brutal, merciless. Besides splicing, doctored images can be generated with other operations.

Figure-3. Historical Example of Doctored Photograph of Iraq War

The photograph in figure 3 had created a mass opposition against the cope presents in the Bagdad, the capital of Iraq at the contemporary time and world had voiced [4] against the human right violation in the Iraq against America aggression in Iraq war. Piers Morgan was sacked as the editor of the Daily Mirror last night as the newspaper's board made an unreserved apology for publishing fake pictures of British troops torturing Iraqi prisoners. Morgan, 39, one of the most controversial tabloid editors of recent times, was dismissed after an afternoon-long board meeting at the Mirror's tower-block headquarters in Canary Wharf, east London. He was immediately escorted from the building by security staff. The pictures provoked fears that they would endanger the lives of British troops in Basra. After a fortnight of recriminations, demands for an apology reached a climax once the Ministry of Defense declared that they could not have been taken in Iraq.

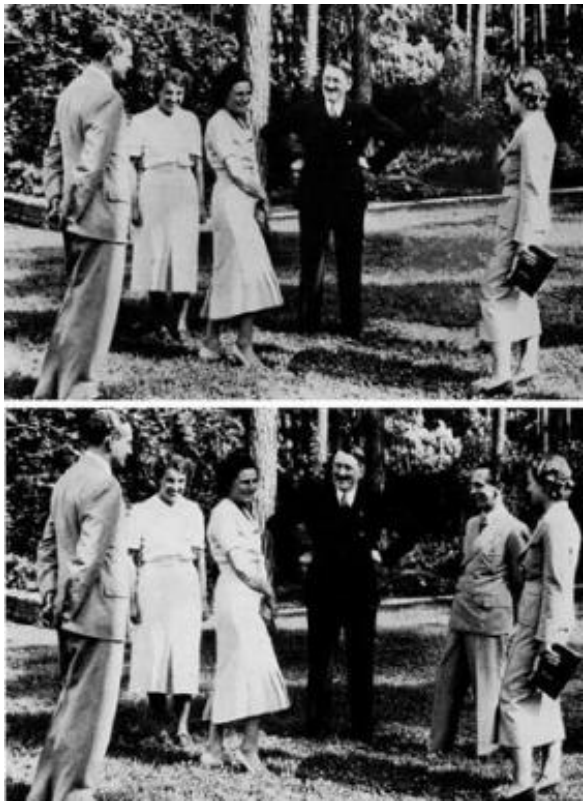

Figure-4. Historical Example of Doctored Photograph of World War

Stalin wasn't the only famous dictator prone to removing friends from his photos. There are several instances of Adolf Hitler having people censored from official snaps too. Here Joseph Goebbels is shed from this otherwise friendly scene of Hitler and friends [6].

Finally we can say that the image processing is an analyzed and manipulation of a digitalized image, especially in order to improve the quality of image processing.

II. IMAGE PROCESSING

DIP (Digital Image Processing) technique can be applied in variety of different fields such as Diagnostic image analysis, Surgical planning, Object detection and Matching, Background subtraction in video, Localization of tumours, Measuring tissue volumes, Locate objects in satellite images, Traffic control systems [7], Locating objects in face recognition, iris recognition, agricultural imaging, and medical imaging.DIP addresses challenges and issues like that loss of image quality, to enhance degraded image. In this paper the review of literature related to DIP is discussed. The major DIP techniques are pre- processing, image compression, edge detection and segmentation are discussed.

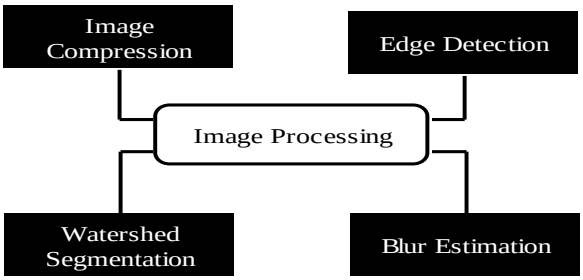

Figure- 5. Image Processing Techniques

Pre-processing of images commonly involves removing low-frequency background noise, normalizing the intensity of the individual particles images, removing or enhancing data images prior to computational processing.

Eapen, et al. [9] have proposed a method to enhance the edges and reduce the noise level in the input images before dealing with segmentation process. In the pre-processing module they included image resizing, histogram equalization, ROI selection (Image cropping) and median filtering. In this method, a global histogram equalization was used which was a perfect technique for contrast and texture enhancement of medical images.

In [110] Sivappriya, et al. proposed medical image edge detection. Medical images pre-processing is an important step in medical image segmentation and 3D reconstruction. Salt and pepper noise were more prevalent in medical images the conventional methods were not effective in filtering salt and pepper noise. Morphological erosion is the best filter for removing salt and pepper noise. The experimental results were more effective for medical image de-noising.

Puri, et al. presented a pre-processing technique to group pixels into "super pixels". They would like to work with "super pixels" which were local, coherent, and which preserve most of the structure necessary for segmentation at the scale of interest. They applied the normalized cut algorithm to produce the super pixel map. Both contour and texture cues were used [8] in the method.

III. IMAGE COMPRESSION

Image compression is an application of data compression that encodes the original image with few bits. The objective of image compression is to reduce the redundancy of the image and to store or transmit data in an efficient form. The main goal is to reduce the storage quantity as much as possible, and the decoded image displayed in the monitor can be similar to the original image as much as can be.

Afifi et al. [11] proposed a system to maintain the quality of image after the image compression process using Wavelet Algorithm. In their work, JPEG and PNG image was used. It was noted that for JPEG image, the size is reduced almost half of original image by using Haar wavelet algorithm, because, JPEG image used lossy compression type, it still maintain the quality and information of the image. Raju, et al. [5] proposed a solution that enhances the image quality. The enhanced image was then segmented using a modified watershed algorithm that uses mean-shift clustering. The enhancement technique proposed a hybrid version that combined wavelets, improved anisotropic diffusion and CLAHE to improve the input satellite image. Three algorithms were used during segmentation. They were conventional mean-shift algorithm, clustering based k-means algorithm and modified watershed algorithm. Various experiments proved that modified watershed algorithm produced better segmentation results when compared with other two algorithms. The proposed watershed algorithm, taken care of the over segmentation process efficiently, but the under segmentation process was not considered.

In medical, image compression using integer multi wavelets transform for telemedicine applications Praveen kumar, et al. [12] have suggested an efficient compression and encoding performance based on Integer multi wavelet transform of medical application. The proposed algorithm resulted in better quality images. The work focused on the implementation of lossless image data. They proposed multi wavelet based compression for this problem, which had been shown to have much better coding efficiency and less computational complexity than existing approaches. The success of high PSNR was due to improvement of the compression ratio.

Sukanya, et al. [6] discussed about compression methods such as JPEG 2000, Embedded Zero Tree (EZW), Set Partition in Hierarchical Trees (SPIHT) and Highly Scalable SPIHT (HS-SPIHT) on the basis of processing time, error comparison, mean square error, peak signal to noise ratio and compression ratio. But to scale the image more so as to get better compression they were using the line-based

Wavelet transform because it requires lower memory without affecting the result of Wavelet transform. The author's proposed a highly scalable image compression scheme based on the Set Partitioning in Hierarchical Trees (SPIHT) algorithm called HS_SPIHT. They proposed HS-SPIHT algorithm which gives us better scalability and reduced bit stream i.e. size of image is reduced well and it also gives better compression ratio. Finally they got reduced bit stream and better scalability.

IV. EDGE DETECTION

Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities.
In [7] Saif, et al. presented two techniques of segmentation algorithms such as Canny edge detection and Otsu thresholding. The effectiveness of the proposed algorithms was evaluated for medical and non medical images. For non medical images two algorithms returned in good segmented images. Canny segmentation is more suitable than Otsu to the tested endoscopic images because there is no clear distinction of the objects from the backgrounds and for MRI grey scale image.

Image segmentation based on watershed and edge detection techniques, Salman, et al.[8] have proposed a combination of K-means, watershed segmentation method, and Difference In Strength (DIS) map to perform image segmentation and edge detection tasks. They have used two techniques; in the first watershed technique with new merging procedures based on mean intensity value is used to segment the image regions and to detect their boundaries. The second technique was the edge strength technique to obtain accurate edge maps of our images without using watershed method. They solved the problem of undesirable over segmentation results produced by the watershed algorithm, when used directly with raw data images. Also, the edge maps they obtained have no broken lines on entire image and the final edge detection result was one closed boundary per actual region in the image.

Karantzalos, et al. [9] brought together two advanced nonlinear scale space representations, anisotropic diffusion filtering and morphological levellings, forming a processing scheme by their combination. The proposed scheme was applied to edge detection and watershed segmentation tasks. Experimental results on automatic olive tree extraction and watershed segmentation showed its effectiveness as a pre-processing tool for edge detection and segmentation from remote sensing images. Their interest has focused on panchromatic high spatial resolution satellite sensor data processing but the developed scheme can also be applied to color and multidimensional image data by processing each channel separately.

Alamri, et al.[10] presented methods for edge segmentation of satellite images, they used seven techniques for this category, Sobel operator technique, Prewitt technique, Kiresh technique, Laplacian technique, Canny technique, Roberts technique and Edge Maximization Technique (EMT) and they were compared with one another so as to choose the best technique. Experiments are carried out for different techniques Kiresh, EMT and Perwitt techniques respectively and are the best techniques for edge detection.

In Enhanced Watershed Image Processing Segmentation Shahzad, et al. proposed a system to enhance the watershed method. The image was converted into grayscale then canny edge detector was applied and after some enhancement processing finally watershed was applied. The evaluation of the segmentation was done by comparing the each object in true segmentation with the object in marker-controlled watershed segmentation or proposed method. Proposed method enhances the result of marker-controlled watershed [11].

Ramadevi, et al. [12] discussed interaction between image segmentation (using different edge detection methods) and object recognition. Edge detection methods such as Sobel, Prewitt, Roberts, Canny, Laplacian of Guassian (LoG) are used for segmenting the image. Expectation-Maximization (EM) algorithm, OTSU thresholding and Genetic algorithms were used to demonstrate the synergy between the segmented images and object recognition. Expectation-Maximization algorithm and OTSU algorithm exhibited stable segmentation effect.

In [13] Nagabhushana Rao, et al. discussed number of image segmentation techniques that can be applied to the security systems. Edge detection is the most common approach for detecting meaningful discontinuities in gray level. The comparative analysis of various image edge detection techniques was presented on finger print images. Evaluation of the images showed that Prewitt, Sobel and Laplacian exhibits better performance, respectively.

Quality Evaluation for Edge Detection of Choromosome G-band Images for Segmentation method was proposed by Wayalun, et al. [14] in which an edge detection of chromosome in G-band type image. It is an important preprocessing step in segmentation. A Chromosome type G-band image has very noise and poor image quality. A lot of edge caused by chromosome can easily mislead the edge detection algorithm. This paper presented analysis of evaluation chromosome G-band image edge detection. It has been appeared 4 different techniques, i.e. Canny, Laplacain, Robert's, and Sobel, on hromosome image type G-band. The results of their study indicate that the Robert's method obtains the highest accuracy and compared with the other three algorithms.

V. WATERSHED SEGMENTATION

A watershed transformation algorithm presented by Belaid, et al. [8] presented in which a new method was proposed for image segmentation using mathematical morphology. The approach was based on the watershed transformation. In order to avoid an over segmentation, they proposed to adapt the topological gradient method. The watershed transformation combined with a fast algorithm based on the topological gradient approach gives good results.

Robust Watershed Segmentation of Noisy Image using Wavelet was addressed by Dey, et al. [7] in which a very effective technique called wavelet thresholding for de-noising. The soft thresholding method was used to analyze the methods of the de-noising system for different levels of DWT decomposition because of its better performance than other de-noising methods. This paper shows that using soft threshold wavelet on the region based Watershed Segmentation on noisy image gives a very effective result.

Thenmozhi, et al. [10] proposed fast watershed transform that detects salient objects in an image. This transformation was entirely different from traditional watershed as it didn't depend on mathematical morphology. It started with sorting image pixel according to their intensity levels and stores them in their corresponding FIFO structure. This method was implemented using chain code algorithm. In addition it was faster than any other watershed algorithm. Integrating this fast watershed with energy based segmentation leads to a new segmentation method called fast water snakes. It reduced the over segmentation and under segmentation due to thick watershed lines, without the need of markers.

VI. LITERATURE SURVEY

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H. Cao et al. [7] designed a new ensemble manipulation detector to simultaneously detect a wide range of manipulation types on local image patches. Fan et al. [4] proposed to correlate statistical noise features with exchangeable image file format header features for manipulation detection.

M. C. Stamm and K. J. R. Liu, [9] proposed different methods not only for the detection of global and local

contrast enhancement but also for identifying the use of histogram equalization and for the detection of the global addition of noise to a previously JPEG-compressed image.

M. Stamm and K. Liu [11] focuses on recovering the possible information about the unmodified version of image and the operations used to modify it, once image alterations have been detected. An iterative method based on probabilistic model is proposed to jointly estimate the contrast enhancement mapping used to alter the image as well as the histogram of the unaltered version of the image. The probabilistic model identifies the histogram entries that are the most likely to occur with the corresponding enhancement artifacts.

P. Ferrara, et al.[8] proposed a paper in which a comparison between two forensic techniques for the reverse engineering of a chain composed by a double JPEG compression interleaved by a linear contrast enhancement is presented. The first approach is based on the well known peak-to-valley behavior of the histogram of double-quantized DCT coefficients, while the second approach is based on the distribution of the first digit of DCT coefficients. These methods have been extended to the study of the considered processing chain, for both the chain detection and the estimation of its parameters. More specifically, the proposed approaches provide an estimation of the quality factor of the previous JPEG compression and the amount of linear contrast enhancement.

G. Cao, Y. Zhao, R. Ni and X. Li [10] proposed two novel algorithms to detect the contrast enhancement involved manipulations in digital images. First for detecting the contrast enhancement based manipulation involved in JPEG compressed images and the second one is used for detecting composite image. The methodologies are (1) Global Contrast Enhancement Detection (2) Identify Source-Enhanced Composite Images.

A novel algorithm is proposed by G. Cao, Y. Zhao, R. Ni and X. Li to identify the source-enhanced composite image created by enforcing contrast adjustment on either single or both source regions. The two source images used for creating cut-and-paste type of forged images may have different color temperature or luminance contrast. So, in order to make the forged image more real, contrast enhancement is performed on either one or both the regions. In this paper, a new method was proposed to identify not only single source enhanced but also both source enhanced cut-and paste type of forged images.

Image processing (picture processing) is the processing of the information contained in a digital image. Digital image is an image that consist of data which is specifically a set of elements) defined on an n-dimensional image regular grid that has the potential for display. [12] These elements are referred to as pixels. The pixels in different images may represent a variety of types of information, such as temperature, pressure, velocity, terrain height or tissue density.

The problems in image processing sometimes happen when the image itself is not clearly enough to be recognized. There is various type of image, such as gray scale image, color image, binary image and etc. A grayscale in digital image is an image in which the value of each pixel is a single sample, that is, carries only intensity information. Images of this sort, also known as black-and-white, are composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest.

Grayscale images are distinct from one-bit black-and-white images, which in the context of computer imaging are images with only the two colors, black, and white also called binary images. Grayscale images are often the result of measuring the intensity of light at each pixel in a single band of the electromagnetic spectrum, for example infrared, visible light or ultraviolet, and in such cases they are monochromatic proper when only a given frequency is captured.

VI. RESEARCH GAP

The research gap in the respective fiend is tabulated in below Table.

Table-1. Research Gap

[1] Article, Authors	[2] Findings	[3] Research Gap
[4] ""Edge-Based Defocus Blur Estimation With Adaptive Scale Selection" by Ali Karaali and Claudio Rosito Jung, IEEE Article 2018 [15]	[5] Blur estimate is computed at edge points [6] novel edge filter is proposed to smooth sparse blur map	[7] Technique presents a novel filter which not comprehensive in nature further research is needed.
[8] "Distributed vector Processing of a new local Multi Scale Fourier transform for medical imaging applications", by Brown, Hongme, IEEE 2005 [16]	[9] A potentially powerful tool that can be applied to medical image processing including texture analysis and noise filtering.	[10] Calculation of ST is computationally intensive, making conventional implementations too slow for many medical applications.
[11] "Registering Pre procedure Volumetric Images With Intra procedure 3-D Ultrasound	[12] Technique for computing the image-to-physical registration for minimally in	[13] The technique had mean registration errors of 2.1-4.4 mm, and 75% capture

Using an Ultrasound Imaging Model", King & Rhode, IEEE-2010 [17]	cardiac interventions using 3-D technique & knowledge of the physics	ranges of 5-30 mm. Further investigation is needed for process accuracy enhancement.
[14] "High Dynamic Range Image Display With Halo & Clipping Prevention" by Gabriele & Marsi, IEEE-2011 [18]	[15] Dynamic range reduction algorithm for high-quality results with a low computational cost and a limited number of parameters.	[16] Fail to prevent formation of common artifacts, such as halos around sharp edges & clipping of highlights, which affect this technique
[17] "Multi-Scale Patch-Based Image Restoration" by Vardan & Elad, IEEE Journals -2016 [19]	[18] Decompose target image to patches, restore each of separately, then merge the results by a plain averaging	[19] Very Slow process and not fit for large images only utilized in medical needed improvement.
[20]	[21]	[22]

VII. CONCLUSION

The article presents a briefly description on image processing technique and their application for industrial advancement. An investigative literature survey is presented of relevant articles from reputed journals. There are numbers of technique which are implemented for enhancing the quality of a digital image before image utilization for further application, but seems that too difficult to trace the exactly the properties of the object. Based on the techniques that are discussed before, each of them has their own advantage and disadvantage. The techniques that being used will be as guidelines to create the algorithm that can approximate the discontinuity of the edges of an object. The type of image also being discussed to make an understanding of image type that leads the problem to occur. Different strategies and technique suggested are not yet up to expectation. Different strategies and technique suggested are not yet up to expectation. From the above discussion, we can conclude that much of the work had been carried.

REFERENCES

[1] "Pattern analysis with two-dimensional spectral localization: Applications of two-dimensional S transforms" by L. Mansinha R. G. Stockwell , R. P. Lowe in Physica A vol. 239 pp. 286-295 IEEE-2017

[2] "Space-local spectral texture map based on MR images of MS patients" by H. Zhu, Mayer, Mansinha L. A, Law C. J. Archibald, Luanne J. R in Mitchell MS: Clin. Lab. Res. IEEE-2018

[3] "Removal of phase artifacts from fMRI data using a stockwell transform filter improves brain activity detection" by B. G. Goodyear H. Zhu R. A., Brown J. R. Mitchell, Magn. Reson in vol. 51 pp. 16-21, IEEE-2012

[4] "A new local multiscale Fourier analysis for medical imaging" by H. Zhu B. G., Goodyear R. A., Brown G. Mayer A. G., Law L. Mansinha J. R. in Mitchell Med. Phys. vol. 30 pp. 1134-1141, IEEE-2009

[5] "Image manipulation detection" by S. Bayram, I. Avcubas, B. Sankur, and N. Memon, J. Electron. Imag., vol. 15, no. 4, pp. 04110201–04110217, 2006.

[6] "Digital image forensics via intrinsic fingerprints" by A. Swaminathan, M. Wu, and K. J. R. Liu, IEEE Trans. Inf. Forensics Security, vol. 3, no. 1, pp. 101–117, Mar. 2008.

[7] "Manipulation detection on image patches using FusionBoost" by H. Cao and A. C. Kot, IEEE Trans. Inf. Forensics Security, vol. 7, no. 3, pp. 992–1002, Jun. 2012.

[8] "Estimating EXIF parameters based on noise features for image manipulation detection" by J. Fan, H. Cao, and A. C. Kot, IEEE Trans. Inf. Forensics Security, vol. 8, no. 4, pp. 608–618, Apr. 2013.

[9] "Forensic detection of image manipulation using statistical intrinsic fingerprints", M. C. Stamm and K. J. R. Liu, IEEE Trans. Inf. Forensics Security, vol. 5, no. 3, pp. 492–506, Sep. 2010.

[10] "Forensic estimation and reconstruction of a contrast enhancement mapping"by M. C. Stamm and K. J. R. Liu, in Proc. IEEE Int. Conf. Acoust., Speech Signal, Dallas, TX, USA, Mar. 2010, pp. 1698–1701.

[11] "Reverse engineering of double compressed images in the presence of contrast enhancement" by P. Ferrara, T. Bianchiy, A. De Rosaz, and A. Piva, in Proc. IEEE Workshop Multimedia Signal Process., Pula, Croatia,Sep./Oct. 2013, pp. 141–146.

[12] "Contrast Enhancement-Based Forensics in Digital Images" by Gang Cao, Yao Zhao, Rongrong Ni IEEE transactions on information forensics and security, vol. 9, no. 3, march 2014

[13] Hao Yang, Zu-shu Li, Fang-zheng Xue, Gang Luo, Zao-sheng Zhong, "Human-simulated intelligent technique for of image processing", 2009 Chinese Control and Decision Conference, : 2009. pp: 268 - 273

[14] Valery D. Yurkevich, Nikita A. Stepanov, "Modulation based detection of cornea in image segmentation", International Congress on Ultra Modern Telecommunications and Control, Systems and Workshops (ICUMT), 2014, pp: 434 - 440

[15] Xumei Lin, Yunfei Liu, Yulu Wang, "Design and Research of blurring intensity in image ", Chinese Automation Congress (CAC), 2018, pp: 3701 – 3705

[16] "Distributed vector Processing of a new local MultiScale Fourier transform for medical imaging applications", by Brown, Hongmei, IEEE Transactions on Medical Imaging 2005, Volume: 24, Issue: 5, pp: 689 - 691

[17] "Registering Preprocedure Volumetric Images With Intraprocedure 3-D Ultrasound Using an Ultrasound Imaging Model", A. P. King, K. S. Rhode, Y. Ma, C. Yao, C. Jansenm R. IEEE on Medical Imaging, 2010 , Volume: 29 , Issue: 3, pp: 924 - 937

[18] "High Dynamic Range Image Display With Halo and Clipping Prevention", Gabriele Guarnieri ; Stefano Marsi ; Giovanni Ramponi, IEEE Transactions on Image Processing Year: 2011, Volume: 20, Issue: 5, pp: 1351 - 1362

[19] "Multi-Scale Patch-Based Image Restoration", Vardan Papyan & Michael Elad- Haifa, Israel, IEEE Transactions on Image Processing, 2016, Volume:25, Issue: 1, pp:249-261, IEEE Journals & Magazines

[20] "Apparent Ultra-High b-Value Diffusion-Weighted Image Reconstruction via Hidden Conditional Random Fields" by Mohammad Javad Shafiee, Shahid A. Haider. Alexander Wong, Dorothy Lui, Andrew Cameron, Ameen Modhafar, Paul Fieguth, Masoom A. Haider, IEEE Transactions on Medical Imaging, 2015, v: 34 , Issue: 5, pp:1111-1124

