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Rapid Approximate Processing Algorithm for 2D to 3D Conversion of HD Video using Depth Fusion Technique

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ABSTRACT: Three- dimension (3D) technology increases the visual quality as compared to two-dimensional (2D) technology. In present era every multimedia device needs 3D technology. The depth information is needed for the generation of 3D from 2D content. Therefore, conversion of 2D video/video into 3D has become an important issue in emerging 3D applications. This work presents a rapid approximate processing unit for 2D to 3D conversion of HD video, which is automatically convert 2D content into 3D content. In this work initially a novel algorithm is proposed. According to that algorithm, there is two different depth map are generated, which is face and edge depth. After generation of both depth map apply depth fusion process which is generate real depth map. Generated depth content is pass from depth video based rendering (DIBR) process for generation of right and left view. A new approach is proposed for DIBR process. Here we will use Matlab 2014b tool for conversion of 2D video into 3D HD Video.

KEYWORDS: HD, 2D to 3D, DIBR, Depth.

I.INTRODUCTION

In video processing taking care of, a 3D substance can give significance information in the meantime, 2D content don't give the significance information.[3] In 3D indicates update visual quality more than two-dimensional exhibits. The essential complexity some place in the scope of 2D and 3D picture s is obviously the proximity of significance in 3D picture s which makes calculation of significance the most basic factor in the midst of progress of picture s from 2D to 3D. . Out of these we think about generally two methods. To begin with, discovering the significance using the edge information of the current 2D picture and second, significance depict by kNN based picking up from coordinated enlightening gathering of picture s. The recently referenced comparative examination wraps up the better of the methods to change over a 2D picture to 3D is kNN based technique. [2]The system of 2D to 3D change contains two phases: significance estimation for a given 2D picture and the significance based adjustment of another picture organized by stereo match. We make two sorts of methods. The essential procedure is taking in a point evaluating from neighborhood picture attributes, The second method relies upon universally surveying the inquiry picture direct from a store of 3D picture s (image+ significance sets or stereo sets) using a nearest neighbor backslide type idea.[6].Today there is an open of 3D capable hardware, for instance, TVs, Blu-Ray players, gaming comforts, and propelled cells, and so forth .While the underlying advance of significance estimation from a lone picture is a trying. Significance layout a monochromatic picture, where a less power exhibits a far partition from the modernized camera, likewise, high power demonstrates a nearest detachment of the mechanized camera. There are two central strategies of 2D to-3D picture change; one is customized procedure and second is self-loader methodology. In self-loader technique a skilled overseer convey the significance to various pieces of picture in a modified system human intervention isn't required in self-loader procedure, For the circumstance of customized methodologies, no manager propels required and a PC estimation normally assesses the significance for a single picture [6]. Self-loader system is logically productive anyway it is repetitive and costly. when the things are excessively moving, the law does not allot generally speaking, which necessities the use of this significance brief in 2D to 3D picture change. In various papers clear up the AI of oversaw

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techniques have been used to physically evaluate the significance plot a lone monocular picture [1-3]. The 3D video banner taking care of has gotten huge thought in visual dealing with. Given advances in 3D show development, individuals try to experience continuously down to earth and novel 3D impacts. Despite delivering preferable visual experiences over standard 2D appears, creating 3D demonstrates have various applications, including broadcasting, films, gaming, photography, camcorders, and preparing. Among the couple of systems fit for delivering 3D content consolidate dynamic significance sensor, triangular stereo vision, besides, 3D delineations rendering. Dynamic procedures use dynamic sensors, for instance, sorted out light and time-of-flight sensor [4], to recoup significance maps. Triangular stereo vision requires diverse cameras to record the substance. Above procedures require unequivocal contraptions and are simply convincing in creating new substance, making them infeasible for 2D substance. [4] corrupted parts of an image so that the reconstructed image looks natural. In real world, many people need a system to recover damaged photographs, designs, drawings, artworks etc. damage may be due to various reasons like scratches, overlaid text or graphics etc.

II.LITERATURE REVIEW

Cut-glass procedure :The most effortless approach to make 3D picture by utilizing of the first 2D picture as the left eye see and produce the correct eye picture by on a level plane moving nearby locales of the first picture, utilizing a reorder procedure. For the disconnection of the nearby locales picture division systems can be utilized, however issue with this methodology is objects are very much isolated, yet for pictures with little items, extensive regions with low surfaces and little degrees of profundity. The Depth is allocated to each article however Depth isn't to every pixel
Depth map Generation:

While watching the world, the human mind incorporates different heuristic Depth signs to create the Depth perception. The significant Depth recognitions are binocular Depth prompts from two eyes and monocular Depth signals from a solitary eye. Binocular visual framework. In this framework the two eyes are utilized together. Human eyes to combine and suit the article at the correct separation monocular visual framework In this impact every eye are utilized independently. Counting center/defocus, movement parallax, relative tallness/size, and surface angle, give different Depth recognitions dependent on human experience Therefore, people can likewise see Depth from the single-see video. Depth map age technique is mix of two methodologies which are single casing and multi frame. In this methodology created Depth map is genuine due to produced 5 Depth guide is for every pixel.

Depth from center/defocus: This methodology decide the separation from the central plane by utilizing the fogginess of low Depth of-field in optical material science, Depth created from spotlight and defocus on central plane yet ,this methodology is gauge the Depth extend by edge haziness and they are achievable for little Depth of-field pictures so it is produce low exactness Depth maps

Depth from geometry: This methodology got the Depth inclination of the scene by utilizing the disappearing point and a solitary info picture is ordered dependent on shading division so Depth is dictated by recognizing straight lines in the picture, however issue with this methodology is computational intricacy.

Depth from picture order: These methodologies order computerized pictures as indoor, outside with geometric components or open air without geometric components. Utilizing the data gathered in the characterization stage a reasonable Depth map is assessed. This methodology confronting some issue like multifaceted nature increment and produced Depth have low precision.

Here we present the previous existing work in the field of 2D to 3D conversion:

A Novel 2D-to-3D Conversion System Using Edge Information, 2010: This work displays a novel calculation that consequently changes over 2D recordings into 3D ones. The proposed calculation uses the edge data to section the video into article gatherings. A Depth outline at that point appointed dependent on an estimated Depth inclination demonstrate. Next, the Depth delineate square based doled out by coordinating with a cross respective channel to produce outwardly agreeable Depth maps productively and furthermore lessen the square ancient rarities. A multi view video can be promptly created by utilizing a Depth video based rendering technique.

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Three-Dimensional Displays: A Review and Applications Analysis, 2011: In this article we survey how show advances have progressed over the most recent ten years and refresh Benton's scientific categorization to incorporate the most recent increases. Our point is to create a showcase scientific classification appropriate for substance makers featuring which shows have basic prerequisites for video conveyance. We additionally break down key specialized qualities of 3D shows and utilize these attributes to recommend the future applications for every class of showcase.

Interactive 3-DTV—Concepts and Key Technologies, 2006: The target of this paper is to give a review about late patterns in the zone of three-dimensional TV (3-DTV). This incorporates the use of new 3-D information portrayal designs, which are intrinsically intuitive and more adaptable than the conventional (two-see) stereoscopic video. In this specific situation, we portray a test 3-DTV framework that depends on the joint circulation of monoscopic shading video and related per-pixel Depth data. From these information, at least one "virtual" perspectives of a certifiable scene can be orchestrated progressively at the collector side (i.e., in a 3-DTV set-top box) by methods for purported Depth video based rendering (DIBR) systems.

The adaptation of 3D stereoscopic video in MPEG-21 DIA, 2003: In this paper, we present portrayals for 3D stereoscopic video transformation that can be used in MPEG-21 computerized thing adjustment. Our portrayal devices give a usefulness of depiction of client attributes and terminal abilities. Specifically, the portrayal of client's showcase introduction inclinations bolsters 3D stereoscopic transformation of 2D video (2D/3D video change) just as 2D conversion of 3D stereoscopic video (3D/2D video transformation) with the goal that clients can appreciate either 2D or 3D stereoscopic video they favor.

TransCAIP: A Live 3D TV System Using a Camera Array and an Integral Photography Display with Interactive Control of Viewing Parameters, 2009 : This paper gives a continuous 3D visual experience by utilizing a variety of 64 camcorders and an essential photography show with 60 seeing bearings. The live 3D scene before the camera cluster is replicated by the full-shading, full-parallax auto stereoscopic show with intelligent control of review parameters. The principle specialized test is quick and adaptable transformation of the information from the 64 multi camera video s to the essential photography organize. In light of video based rendering procedures, our change strategy first renders 60 novel video s relating to the survey bearings of the showcase, and after that organizes the rendered pixels to create a basic photography video. For continuous handling on a solitary PC, all the transformation forms are executed on a GPU with GPGPU procedures.

Video Distortions in Stereoscopic Video Systems, 1993: This paper examines the starting points, attributes and impacts of video twists in stereoscopic video frameworks. The geometry of stereoscopic camera and show frameworks is introduced first. This is trailed by the examination and diagrammatic introduction of different video bends, for example, Depth plane ebb and flow, Depth non-linearity, Depth and size amplification, shearing mutilation and cornerstone twisting. The variety of framework parameters is likewise dissected with the assistance of plots of video geometry to demonstrate their impacts on video contortions.

Geometrical Analysis of Puppet-Theater and Cardboard Effects in Stereoscopic HDTV Images, 2006: This paper gives an account of this investigation, especially on the setting of the optical tomahawks of three dimensional (3-D) cameras, which has gotten little consideration previously. To start with, we recognized the conditions for setting the optical tomahawks that keep up linearity amid the change from genuine space to stereoscopic video s. We at that point elucidated, in geometrical terms, the shooting and review conditions and furthermore conditions under which the manikin theater impact and cardboard impact happen. The outcomes demonstrated that the parallel camera design, by which optical tomahawks are held parallel to one another, does not create the manikin theater impact as the evident amplification (horizontal amplification) of a shooting target isn't reliant on the shooting separation.

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As per the all previous work there is no any researcher who solves the most important and critical factors and that are:

- **Depth map quality-** In 3D view important part is 3rd dimension which is depth, but In previous 2D to 3D conversion method generated depth map quality is not good so generated 3D output is look like artificial.
- **Time complexity-** In 2D to 3D conversion method at the algorithm level time complexity is the main issue. Previous approach requires a large time for generation of depth map, left and right view.
- **Visuality quality -** In 2D to 3D conversion process 3D content is generated by 2D content. This conversion process affects the visual quality of generated 3D content.
- **Virtual depth-** In the previous algorithm generated depth map is look like virtual depth.

III.PROPOSED METHADODOLOGY

Proposed approach initially take image/video size of 720x1280 (720p) as an input. For reduction in memory and time complexity point of view approximation is applied. Here approximation is done by shrinking of video from 720X1280 to 320x360. Here basically we generate two types of depth images and after that we use depth fusion approach. Generated shrink RGB input is converted into YCrCb. Now for reduction in hardware & latency complexity input Y (8 bit) color is converted into 6 bit. Here two different depth map is generated first one is face depth and the second one is edge depth. Blurring effect and energy minimization is applied to generated face depth. For edge depth generation input is passed from edge detection process after this generated output is passed from blur effect with energy minimization. Here energy minimization is done by subtracting the input pixel with some constant value. At the last step of depth map generation merge/blending process is applied. Both generated depth map is converted in final depth map and bit size of 6 bit is changed into 8 bit.

Depth video based rendering: In this stage generated depth map is produced right & left video by using of camera configuration formula as we can see in Fig.3.3. In previous approach for reduction of hardware complexity in DIBR $(1/Depth)$ is replaced with $(256-Depth)/256$, for parallelism it requires large hardware unit. For reduction of this problem some changes are applied in the previous DIBR formula and that change is interchange of left & right video formula. Hence replaces $(256-Depth)/256$ with $(Depth/256)$ at a same time left and right offset is calculated by same hardware & at parallel process pre right video is generated. Here $Pos = (Screen\ Width/32)$. Now at nal stage right video and left video is generated with that offset value.

Hole Filling: Due to depth map and DIBR process generated left & right view are having very small holes. In this proposed approach hole size is very small so there is no need of Laplace filter, edge based filter & interpolation hence smooth filter is used. This filter requires a small hardware unit with less computation time compared to other approaches. Now generated left and right video is resized in original size of 720 X 1280. Here for resize video into original format bicubic interpolation approach is used.

Generated left and right video are combined with Cb and Cr content and it is passed to accurate YCbCr to RGB conversion unit. Now the generated right and left video becomes 1280 X 720 X 3, while YCbCr to RGB conversion is not a part of proposed algorithm it is a generalized one.

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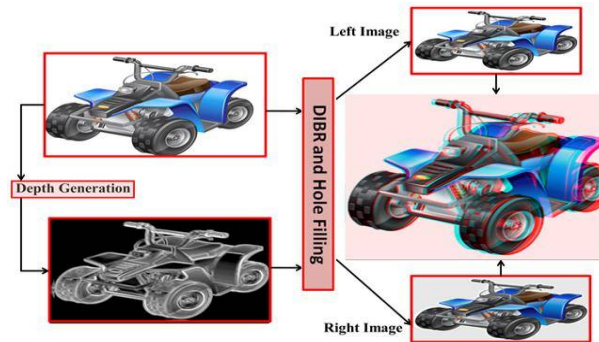


Fig 1. Proposed methodology with an example

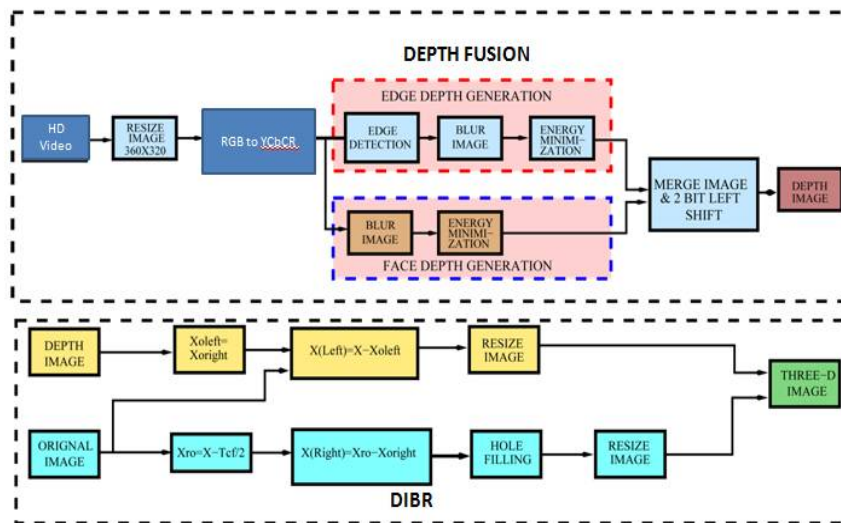


Fig 2. Proposed Algorithm

IV. EXPERIMENTAL RESULTS

The proposed algorithm 2D to 3D conversion of HD video is implemented by using of matlab and subjective & objective analysis is done for different type of depth perception with have different test images. Here we have different depth perception images are taken and according to that result are generated.

Objective analysis: Memory complexity problem is reducing which results in improvement of 39%. Time complexity problem is reducing which results in improvement of 35%.

Here four different image quality parameters are used. Here structural information, structural similarity index metric (SSIM) parameter is used this is a new parameter. this parameter will check structure similarity between main image and reference image and according to that it will give score. According to proposed design is based on parallelism.

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Table 1: Parameter values for depth map generation

| Parameter | Edge Based[21] | Real Time[16] | Proposed |
|----------------|----------------|---------------|----------|
| Memory(Mbyte) | 9.352 | 7.201 | 4.421 |
| Time(ms) | 7460 | 389 | 245 |
| PSNR(db)[36] | 20.923 | 18.796 | 20.253 |
| SSIM[28] | 0.852 | 0.742 | 0.748 |
| Correlation | 0.984 | 0.971 | 0.969 |
| Similarity (%) | 82.299 | 72.975 | 80.804 |

V.CONCLUSION

Proposed algorithm of 2D to 3D conversion is a combination of depth map, DIBR and hole filling. For depth map generation edge detection, Gaussian filter, image shrinking and color map conversion process are require. Depth image based rendering process is initially implemented at algorithm level and calculated processing time results 50% reduction. For per frame time calculation proposed DIBR algorithm is implemented PSNR, SSIM, RFSIM, FSIM, GMSD, correlation and absolute similarity are image quality parameters. All these parameters are used for image quality measurement. Overall proposed 2D to 3D conversion approach is implemented on the algorithm level. At algorithm level all analysis is done in matlab. Generated 3D content from proposed algorithm is analyzed by subjective and objective analysis. At objective analysis the proposed algorithm achieves reduction in time complexity. It requires 245 msec per frame. Image/video applications require large memory unit so this proposed algorithm reduces the problem of the large memory unit. Proposed approach requires only 4.421 Mbyte. The proposed approach achieves 39% reduction in memory complexity as compare edge based [16] and real time [21] process. Similar generated 3D content is passed from different image parameters, which results small degradation in image quality. At subjective analysis of proposed 3D content results visualization of 3D output is at comfortable zone and depth of 3D output is at good zone.

REFERENCES

- [1] N. Holliman, N. Dodgson, G. Favalora, and L. Pockett, "Three dimensional displays: A review and applications analysis", IEEE Trans. Broadcasting, vol. 57, no. 2, pp. 362,371, Jun. 2011.
- [2] Stereo Photography [Online]. Available: <http://www.3dphoto.net>
- [3] C. Fehn, R. Barre, and S. Pastoor, "Interactive 3D-TV: Concepts and key technologies", Proc. IEEE, vol. 94, no. 3, pp. 524-538, Mar. 2006.
- [4] IMAX [Online]. Available: <http://en.wikipedia.org/wiki/IMAX>
- [5] M. Kim, J. Nam, and W. Baek, "The adaptation of 3-D stereoscopic video in MPEG-21 DIA", Signal Proc. Video Commun., vol. 18, no. 8, pp. 685,697, 2003.
- [6] Y. Taguchi, T. Koike, and K. Takahashi, TransCAIP: "A live 3DTV system using a camera array and an integral photography display with interactive control of viewing parameters", IEEE Trans. Vis. Comput. Graph., vol. 15, no. 5, pp. 841,852, Sep.-Oct. 2009.
- [7] A. Woods, T. Docherty, and R. Koch, "Video distortions in stereoscopic video systems", in Proc. SPIE (Stereoscopic Displays Appl.), vol. 1915. 1993, pp. 36,48.
- [8] H. Yamanoue, M. Okui, and F. Okano, "Geometrical analysis of puppetheater and cardboard effects in stereoscopic HDTV images", IEEE Trans. Circuits Syst. Video Technol., vol. 16, no. 6, pp. 744,752, Jun.2006.
- [9] C. Fehn, "A 3D-TV system based on video-plus-depth information", in Proc. Asilomar Conf. Signals Syst. Comput., vol. 2. 2003, pp.1529,1533.
- [10] L. Zhang and W. Tam, "Stereoscopic video generation based on depth images for 3D-TV", IEEE Trans. Broadcasting, vol. 51, no. 2, pp. 191,199, Jun. 2005.
- [11] D. Nagahara and S. Takahashi "Mobile robot control based on information of the scanning laser range sensor", in Proc. IEEE Int. Workshop Advanced Motion Control, Mar. 2010, pp. 258,261.
- [12] J. Zhu, L. Wang, R. Yang, and J. Davis, "Fusion of time-of-flight depth and stereo for high accuracy depth maps", in Proc. IEEE Int. Conf. Comput. Vision Pattern Recognit., Jun. 2008, pp. 1,8.

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Visit: www.ijirset.com

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- [13] J. Zhu, L. Wang, J. Gao, and R. Yang, "Spatial-temporal fusion for high accuracy depth maps using dynamic MRFs", IEEE Trans. Pattern Anal. Mach. Intell., vol. 32, no. 5, pp. 899,909, May 2010.
- [14] L. Zhang, C. Vazquez, and S. Knorr, "3D-TV content creation: Automatic 2D-to- 3D video conversion", IEEE Trans. Broadcasting, vol. 57, no. 2, pp. 372,383, Jun. 2011. 75
- [15] Stelmach, L.; Wa James Tam; Meegan, D.; Vincent, A., "Stereo video quality: effects of mixed spatio-temporal resolution," Circuits and Systems for Video Technology, IEEE Transactions on , vol.10, no.2, pp.188,193, Mar 2000
- [16] Sung-Fang Tsai; Chao-Chung Cheng; Chung-Te Li; Liang-Gee Chen, "A real-time 1080p 2D-to-3D video conversion system," Consumer Electronics (ICCE), 2011 IEEE International Conference on , vol., no., pp.803,804, 9-12 Jan. 2011
- [17] Jungwoo Park ; Changick Kim; "Extracting focused object from low depth-of-eld video sequences". Proc. SPIE 6077, Visual Communications and Video Processing 2006, 60771O (January 18, 2006); doi:10.1117/12.642319.
- [18] Yi-Min Tsai; Chang, Yu-Lin; Liang-Gee Chen, "Block-based Vanishing Line and Vanishing Point Detection for 3D Scene Reconstruction," Intelligent Signal Processing and Communications, 2006. ISPACS '06. International Symposium on , vol., no., pp.586,589, Dec. 2006
- [19] Sebastiano Battiato ; Salvatore Curti ; Marco La Cascia ; Marcello Tortora ; Emiliano Scordato; "Depth map generation by video classification". Proc. SPIE 5302, Three-Dimensional Video Capture and Applications VI, 95 (April 16, 2004); doi:10.1117/12.526634.
- [20] Yong Ju Jung ; Aron Baik ; Jiwon Kim ; Dusik Park; "A novel 2D-to-3D conversion technique based on relative height-depth cue". Proc. SPIE 7237, Stereoscopic Displays and Applications XX, 72371U (February 18, 2009); doi:10.1117/12.806058.
- [21] Chao-Chung Cheng; Chung-Te Li; Liang-Gee Chen, "A novel 2D-to-3D conversion system using edge information," Consumer Electronics, IEEE Transactions on , vol.56, no.3, pp.1739,1745, Aug. 2010 doi: 10.1109/TCE.2010.5606320.
- [22] H. Murata et al.: "Conversion of Two-Dimensional Images to Three dimensions", SID Digest of Technical Papers, vol. 26, pp859-862 (1995) T. Okino et al.: "New Television
- [23] Yukinori Matsumoto ; Hajime Terasaki ; Kazuhide Sugimoto ; Tsutomu Arakawa; "Conversion system of monocular video sequence to stereo using motion parallax". Proc. SPIE 3012, Stereoscopic Displays and Virtual Reality Systems IV, 108 (May 15, 1997); doi:10.1117/12.274446.
- [24] Chan-Hee Han; Si-Woong Lee; Hyun-Soo Kang, "Low-complexity depth map generation for real-time 2D-to-3D video conversion," Consumer Electronics (ICCE), 2013 IEEE International Conference on , vol., no., pp.185,186, Jan. 2013
- [25] Wan-Yu Chen; Chang, Yu-Lin; Shyh-Feng Lin; Li-Fu Ding; Liang-Gee Chen, "Efficient Depth Video Based Rendering with Edge Dependent Depth Filter and Interpolation," Multimedia and Expo, 2005. ICME 2005. IEEE International Conference on , vol., no., pp.1314,1317, July 2005
- [26] Hao Liu; Wei Guo; Chao Lu; Jizeng Wei, "An Efficient Stereoscopic Game Conversion System for Embedded Platform," Trust, Security and Privacy in Computing and Communications (TrustCom), 2011 IEEE 10th International Conference on , vol., no., pp.1235,1240, Nov. 2011.
- [27] Kahng, A.B.; Seokhyeong Kang, "Accuracy-configurable adder for approximate arithmetic designs," Design Automation Conference (DAC), 2012 49th ACM/EDAC/IEEE , vol., no., pp.820,825, June 2012 76
- [28] ZhouWang; Bovik, A.C.; Sheikh, H.R.; Simoncelli, E.P., "Video quality assessment: from error visibility to structural similarity," Video Processing, IEEE Transactions on , vol.13, no.4, pp.600,612, April 2004 doi: 10.1109/TIP.2003.819861
- [29] Lin Zhang; Zhang, D.; Xuanqin Mou, "RFSIM: A feature based video quality assessment metric using Riesz transforms," Video Processing (ICIP), 2010 17th IEEE International Conference on , vol., no., pp.321,324, 26-29 Sept. 2010
- [30] Lin Zhang; Zhang, D.; Xuanqin Mou; Zhang, D., "FSIM: A Feature Similarity Index for Video Quality Assessment," Video Processing, IEEE Transactions on , vol.20, no.8, pp.2378,2386, Aug. 2011
- [31] Xue, W.; Zhang, L.; Mou, X.; Bovik, A., "Gradient Magnitude Similarity Deviation: A Highly Efficient Perceptual Video Quality Index," Video Processing, IEEE Transactions on , vol.19, no.9, pp.1,1
- [32] ITU-R Recommendation BT.500-10, (2000). "Methodology for the subjective assessment of the quality of television pictures".
- [33] G. Sapiro, V. Caselles, and C. Ballester, "Image inpainting", in Proc. SIGGRAPH, pp. 417-424, 2000.
- [34] A. Criminisi, P. Perez, and K. Toyama, "Region filling and object removal by exemplar-based image inpainting," IEEE Transactions on Image Processing, vol. 13, no.9, pp. 1200-1212, 2004.
- [35] Marcelo Bertalmio, Luminita Vese, Guillermo Sapiro, Stanley Osher, "Simultaneous Structure and Texture Image Inpainting", IEEE Transactions On Image Processing, vol. 12, No. 8, 2003.
- [36] Yassin M. Y. Hasan and Lina J. Karam, "Morphological Text Extraction from Images", IEEE Transactions On Image Processing, vol. 9, No. 11, 2000
- [37] Eftychios A. Pnevmatikakis, Petros Maragos "An Inpainting System For Automatic Image Structure-Texture Restoration With Text Removal", IEEE trans. 978-1-4244-1764, 2008
- [38] S.Bhuvaneshwari, T.S.Subashini, "Automatic Detection and Inpainting of Text Images", International Journal of Computer Applications (0975 – 8887) Volume 61– No.7, 2013
- [39] Aria Pezeshk and Richard L. Tutwiler, "Automatic Feature Extraction and Text Recognition from Scanned Topographic Maps", IEEE Transactions on geosciences and remote sensing, VOL. 49, NO. 12, 2011
- [40] Xiaoqing Liu and Jagath Samarabandu, "Multiscale Edge-Based Text Extraction From Complex Images", IEEE Trans., 1424403677, 2006
- [41] Nobuo Ezaki, Marius Bulacu Lambert , Schomaker , "Text Detection from Natural Scene Images: Towards a System for Visually Impaired Persons" , Proc. of 17th Int. Conf. on Pattern Recognition (ICPR), IEEE Computer Society, pp. 683-686, vol. II, 2004
- [42] Mr. Rajesh H. Davda1, Mr. Noor Mohammed, " Text Detection, Removal and Region Filling Using Image Inpainting", International Journal of Futuristic Science Engineering and Technology, vol. 1 Issue 2, ISSN 2320 – 4486, 2013
- [43] Uday Modha, Preeti Dave, " Image Inpainting-Automatic Detection and Removal of Text From Images", International Journal of Engineering Research and Applications (IJERA), ISSN: 2248-9622 Vol. 2, Issue 2, 2012
- [44] Muthukumar S, Dr.Krishnan .N, Pasupathi.P, Deepa. S, "Analysis of Image Inpainting Techniques with Exemplar, Poisson, Successive Elimination and 8 Pixel Neighborhood Methods", International Journal of Computer Applications (0975 – 8887), Volume 9, No.11, 2010