November-December 2019
ISSN: 0193-4120 Page No. 6351 - 6355

Intelligent Digital Transformation Mechanism of 2D image to Realistic 3D Object using image Processing Algorithm

M. Narasimha Raju, N. Kumaran, V. Chandra Sekhar
M. NarasimhaRaju, Research Scholar,CSEDepartment,Annamalai University, Annamalainagar, Tamilnadu, India.(Email: mnraju234@gmail.com)
Dr. N. Kumaran, Assistant Professor,CSEDepartment,Annamalai University, Annamalainagar, Tamilnadu, India.
Dr. V. Chandra Sekhar, Associate Professor,CSE Department, S.R.K.R.Engineering College, Bhimavaram, A.P. India.

Article Info
Volume 81
Page Number: 6351 - 6355
Publication Issue:
November-December 2019

Article History
Article Received: *5 March 2019*
Revised: *18 May 2019*
Accepted: *24 September 2019*
Publication: *28 December 2019*

Abstract:

2D to 3D conversion has been a very much indispensable field of research due to its importance in many fields like robotic vision, intelligent healthcare etc., There is huge attraction among consumers for 3D hardware and technology. This has been an area of study for a decade. This paper presents a survey of existing techniques and algorithms that prevail in order to perform 2D to 3D conversion in a much accurate and realistic manner. The paper discusses range of techniques from pattern recognition, depth estimation in images, automatic conversion using local parameters of images, Neighborhood parameters of pixels in images etc., The proposed system is discussed as a more accurate version over the existing problem.

Keywords*: Image Processing, 3D Conversion, etc*

I. INTRODUCTION

3D motion pictures are becoming much common these days. The consumer reception of the technology paves way for areas like 2D to 3D image conversion. Industry is looking for optimal solutions in order to build salable products to increase the return on investment. This area is a wide field of research. The parameters and options considered in each and every technique is different. The artificial intelligence perspective with Neural Networks is also a viable option to improve the accuracy. Various machine learning algorithms and hardware oriented solutions like GPU are also considered good solutions.

There have been variety of solutions involving Image Processing and Pattern Matching. Considerable work has been done in machine learning and Deep Learning is a promising solution. Stereovision, Filtering, Segmentation and cascading image features are all possible solutions that have proven as good solutions. But the area is still awaiting better solutions to improve the precision, accuracy and hence the realistic nature of conversion can be preserved. This gives way for more possibilities in this area for improvement. Effectiveness and Efficiency can be taken for parameters in the case of improvement. Chapter II discussed existing works and their classification. Chapter III proposes the system architecture. Chapter IV suggests the Conclusion and scope for future work.

II.RELATED WORK

The process of 2D to 3D image conversion is performed with the help of several techniques. The following is a survey of various such technologies which are classified as below. They are not individual techniques but often are used as a bundle with each other. But improvisation in related work has been shown in any one of these individual techniques. Hence the list is rendered as a classification.

A. Image Processing

Image processing is a wide area of options for accommodating the conversion process. There are so many local parameters of images that can be considered for the conversion and therefore its optimization. The following are some of the works.

Sadhanaet.al(2016)[1] propose a system where automatic conversion from 2D to 3D is proposed using local attributes. There are two techniques used namely depth estimation and global estimation of the entire depth map of query image. The nearest neighbor regression algorithm is used here.

Gao et al(2015) [2]present a paper on a method for the quality assessment of the 3D objects which is actually formed from 2D data. The point cloud and information like height are used to perform pattern matching of height data in real locations.

Liu et al(2016), [3] in this paper, present an issue and solution about face alignment. They present a regression model for this purpose. The proposed idea selects the features which can be relied upon for face alignment by going for a different idea in regression using a concept called repressors unlike least squares. To find the pose variation the system proposes deep convolution techniques and artificial neural network.

Guo et al(2016)[4], In this work, a new method based on dominant Local Binary Pattern (LBP) which can be used to address the issues of scale variation while performing pattern classification especially the texture. The technique suggest usage of noise filtering with Gaussian filters. A histogram is formed in this technique from the features and then LBP is built therefrom. Different scales are addressed by identifying the frequency in different scales and the invariant object features therein.

Liu et al(2018)[5], present in this paper an approach to 3-D building model retrieval based on two steps with which the building model is classified. The distance is transformed and the features are extracted. Then they are classified. The 3D model is projected and downcast to 2D images from the extracted features and viewpoints.

Chatoux et al(2019) [6] propose a full-vector gradient for multi-spectral sensors. This technique optimizes the visual content from input channels taking into account their nature of not grasping the input in non-orthogonal fashion. Independent of the number of channels and the visual content is much general in nature.

Wang et al(2019, [7] suggest a convolution neural network-based in order to upgrade the accuracy part. Deep learning is used in order to perform the classification and pattern recognition. Later the image is reconstructed.

Cui et al(2019)[8] propose a simple but efficient spectral filter tracking (SFT) method with graph based concerns. Here the region of interest is modeled as a grid. Regression model is imposed and the filtering is performed for classification. This helps in learning.

Debayle et al(2006)[9] suggest General Adaptive Neighborhood Image Processing (GANIP) approach. This is based on neighborhood information which is used for pattern matching and classification. Context dependency is underlying principle for analysis. The principle is flexible because it takes the adaptive path.

Huitron et al(2014) [10] insist on conversion to 3D video color conversion from 2D video sequence. This is implemented in different hardware platforms also. The neighbor frame information is used for color conversion which is most reasonable and also GPU implementation improves the performance,

Lin et al(2011) [11] present in this paper, that the depth map is prepared by separating the foreground and background information by using artificial intelligence and neural networks. First the separation of foreground and background happens and then the depth map is constructed from the features studied. The information are then merged for learning purposes.

Yaras et al(2010) [14] suggest about the True-3D imaging where the light distribution is taken into account. The light distribution information is missed in many systems which misleads the conversion of 2D to 3D information. But this proposed system does take this information into account.

B. Pattern Matching

Pattern Matching and thereby performing the conversion by reconstruction of image parameters is another technique. The following is the summary of works regarding the same.

Vincent et al(2015) [15] proposed a method for conversion using image matching with sub images which are local in nature. In this system camera position is estimated, the anchor points are calculated, then depth estimated. From all this information the conversion is performed.

Al-Osaimi et al(2016) [16] suggests that there is possibility to build a 2D representation from which easily 3D conversion can be done called 3DoF. The information of all 3DoF rotations and the features are used to construct the invariant 3DoF patterns. This also overcomes the scale problem.

C. Depth Estimation

Depth Estimation is unavoidable area in the 2D to 3D conversion platform. The conversion is based on calculation of depth as the primary step after segmentation, finding the region of interest , classifying the local and global parameters etc., The following works through more light into such solutions.

Galabov (2014) [17] This proposed algorithm is a series of 8 steps which are color based segmentation, rule based region detection to find specific areas of interest, Qualitative depth map construction, image classification as indoor or outdoor with or without geometric appearance, vanishing lines detection, geometric depth map detection, consistency verification of detected region, fusion of qualitative depth map and the geometric depth map.

Dholariyaet.al(2015), [18] present a proposed system to show how 2D to 3D conversion is done using Depth Estimation. In the process, image is taken as input, regions are grouped as per contour information, depth assignment, cross bilateral filtering and image depth based rendering is performed to acquire the output. Support Vector Machine is used to identify the region of interest.

Konrad et al(2012) [19] developed a simple and efficient 2D-to-3D image conversion algorithm. The parameters like Average Cross covariance, Median Cross Covariance and Processing time are calculated for the proposed algorithm with warp and no warp and conversion for 3D with Make3D algorithm over the Kinect Depth dataset performing the LOOCV tests and with the help of K-NN algorithm.

Patil et al [20] present their work on 2D-to-3D image or video conversion with depth estimation. The objects structure while at motion is considered for the conversion purpose. Color and texture are other information taken into account.

D. Machine Learning

Machine learning is an indispensable area where classification, prediction, association and further statistical analysis is done with images and image parameters.The following works show some innovative solutions in the field of image conversion to 3D format.

Chahal et al(2015) [21] present in this paper, neighborhood features that preserve the point information which are non linear or linear in nature. This is a supervised learning technique and gives a smooth 3D output.

Zhang et al(2019) [22]present a work on estimation of pose variation. Possible pixel changes are taken into account too. Convolution neural networks are used here. Frontal and non-frontal facial features are also used for pose variation estimation.

Fang et al(2019) [23]present their work in the field of Stereoscopic saliency detection using 3D convolution neural networks and artificial learning techniques for classification and learning purposes.

Guo et al(2016) [24] propose a deep learning neural network which is a supervised classification technique by reducing the loss involved in dimensional space transformation from high to low dimensions. The Euclidean distance of features directly corresponds to the semantic similarity of images.

E. Neighbourhood Analysis

Much appropriate is the analysis of pixels and nearby ones in order to reconstruct the 2D to 3D image. This involves many machine learning algorithms. It is classified as a separate area because of its higher and indispensable nature of applicability. Following works allow detailed understanding of such systems.

Spencer et al(2019) [25] present a Selective segmentation method where the author defines the new model with techniques like finding contours, distances, random walk in order to perform neighborhood based analysis of image content input. This helps to classify and match the region of interest. Kampffmeyer et al(2019) [26], the authors propose a pure Connectivity Net (ConnNet). This helps to find the martching pixels in the neighborhood and helps to match even cascaded content. This would help in the 2D to 3D content and vice versa. The above chapter content presents the possible solutions for the conversion of 2D to 3D format based on various techniques and technologies.

III.PROPOSED SYSTEM& RESULTS

The proposed system presents the basic system block diagram for the process of conversion of 2D to 3D format for images in realistic fashion using image processing.

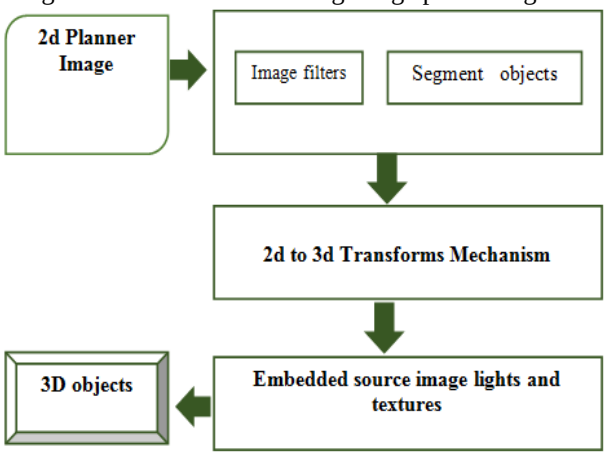

Fig 1: Block Diagram of Primary 2D to 3D Conversion

The above block diagram shows the steps in the conversion of image from 2D to 3D format. The steps are explained in detail as below.

i. Image Filtering
ii. Image Segmentation
iii. 2D to 3D Transformation Algorithms
iv. Reproduction of local parameters like image lighting and textures

i. Image Filtering

Filtering in spatial domain involves the processes like enhancing some features and removing unwanted features. For example, constructing an occluded object or objects in dark lighting backdrop. It involves smoothing, sharpening, edge enhancement etc.,

ii. Image Segmentation

Image Segmentation is a process of partitioning the image to various multiple segments in order to change the representation of the image or perform pattern matching. This involves labeling pixel groups based on location and geometry based on contours and silhouettes.

iii. 2D to 3D Transformation Algorithms

This section involves various steps involved in the conversion of 2D to 3D image. The specific technique based algorithms are used here.

Using Image Processing, The basic technique is to perform segmentation of the image in 2D format. The region of interest is found from them. Therefrom edge information and the depth estimation happens. Based on neighborhood information of pixel and local attributes like color, texture, spatial and geometric information, the 3D visualization is done with the help of classification and machine learning algorithm. Thus the 3D conversion happens. The parameters and options considered in each and every technique is different. The artificial intelligence perspective with Neural Networks or Deep Learning is also a viable option to improve the accuracy. [27]

The algorithm for depth estimation is found as below.

1. Choose the appropriate image content.
2. Divide the image into B number of blocks.
3. Choose the edges of the each block and name them uniquely.
4. N is number of segments.
5. Eav is average number of edges in total edges of a block.

$$E_{av} = \frac{\sum_{i=1}^{N} E_i}{N}$$

6. Euclidean Distance from one point to center point is calculated iteratively.
7. The distances are merged and the weight is calculated.

$$W_n = \frac{E_n}{\sum_i^T E_n}$$

8. Average Global depth gradient is Gn.
9. Global depth $D_{global} = \sum_{i=1}^{T} W_n \times G_n$ is calculated
10. After the depth estimation, the cascading of the local image attributes usually helps in 3D visualization.

Machine Learning is a viable technique that comes handy for classification, association, correlation and prediction purposes using image attribute information. The pixel's local attributes and global attributes of images are also used. Especially when it comes to occlusion and filling the gaps during 3D visualization of the 2D information, the machine learning techniques helps a lot.

The proposed system aims at 2D to 3D conversion with image processing techniques and machine learning techniques. The prime issues in the 2D to 3D conversion like reconstruction from image sections that are from poor background lighting, local and global image attributes, occluded information that has to be produced with highly realistic manner are addressed in the system. The usage of machine learning techniques like deep learning help to improve the accuracy.

Basically the segmented image sections are probed for image's local parameters, cascading them in order to make them 3D like building a pyramid by step wise enhancement of parameters, then reconstructing the 3D features.

iv. Reproduction of local parameters like image lighting and textures

While doing the conversion it would be mandatory to preserve the settings of the original image in 3D format like the lighting, geometry, texture, color schemes etc in both indoor and outdoor image parts.

The system block diagram is a set of primary steps that are used for the conversion process. Different algorithms can be served for according to the purpose. Their performance is compared.

The following is the comparison of the performance of previous existing systems. The peak identification rate is found to be 97.2%. The proposed system aims at presenting a better identification rate with the improvisation at the algorithm level.

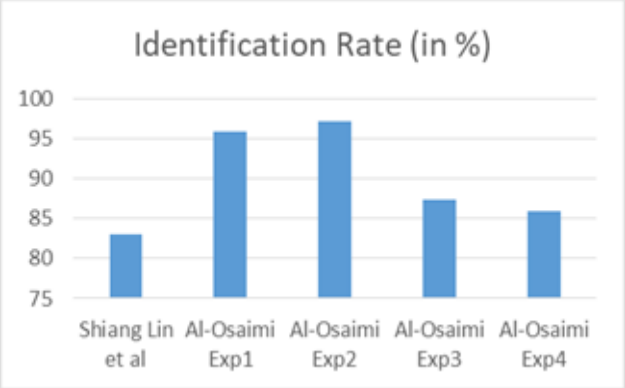

Fig 1: Comparison of Identification rate of existing systems

IV.CONCLUSION

The proposed system presents an overlay of the system for 2D to 3D conversion with a performance better than that of the existing systems. A detailed survey of existing works is presented in the paper and the performance level considering the identification rate as a parameter has been presented in the paper. The proposed work targets the algorithm level improvisation and does not look into the hardware level improvisation.

REFERENCES

1. DhumalSadhana, JagtapSarika, JagtapVarsha, TawareSaee," Review on Automatic Conversion 2d To 3d Image", International Journal of Engineering Science and Computing, March 2016,Vol 6, No 3, pp 2409-2411
2. LipengGao , Wenzhong Shi , YiliangWan ," A Quality Assessment Method For 3d Road Polygon Objects", The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XL-3/W3, 2015 ISPRS Geospatial Week 2015, 28 Sep - 03 Oct 2015, La Grande Motte, France, pp 45-49
3. QingshanLiu, Jiankang Deng, and Dacheng Tao, "Dual Sparse Constrained Cascade Regression for Robust Face Alignment", IEEE Transactions On Image Processing, Vol. 25, No. 2, February 2016, pp 700-712.
4. ZhenhuaGuo,Wang, Jie Zhou, Jane You, "Robust Texture Image Representation by Scale Selective Local Binary Patterns", IEEE Transactions On Image Processing, Vol. 25, No. 2, February 2016, pp-687-699
5. Tao Liu, Jin Gao, And Yuchen Zhao, "An Approach To 3D Building Model Retrieval Based On Topology Structure And View Feature", IEEE Access, Volume 6, 2018, pp- 31685-31694
6. HermineChatoux , Noël Richard, François Lecellier, and Christine Fernandez-Maloigne, "Full-Vector Gradient for Multi-Spectral or Multivariate Images" IEEE Transactions On Image Processing, Vol. 28, No. 5, May 2019, pp 2228 - 2241
7. Lizhi Wang ,Tao Zhang, Ying Fu , Hua Huang, "HyperReconNet: Joint Coded Aperture Optimization and Image Reconstruction for Compressive Hyperspectral Imaging", IEEE Transactions On Image Processing, Vol. 28, No. 5, May 2019, pp 2257-2270
8. Zhen Cui , YouyiCai, WenmingZheng , ChunyanXu ,Jian Yang," Spectral Filter Tracking", IEEE Transactions On Image Processing, Vol. 28, No. 5, May 2019 pp-2479-2489
9. Johan Debayle, Jean-Charles Pinoli, "General Adaptive Neighborhood ImageProcessing:Part I: Introduction and Theoretical Aspects", Springer J Math Imaging, Vol 25, 2006, pp- 245-266
10. V. Gonzalez-Huitron, E. Ramos-Diaz, V. Kravchenko, V. Ponomaryov, "2D to 3D Conversion Based on Disparity Map Estimation", Springer E. Bayro-Corrochano and E. Hancock (Eds.): CIARP 2014, LNCS 8827, pp. 982-989, 2014.
11. Guo-Shiang Lin, Han-Wen Liu, Wei-ChihChen, Wen-NungLie, and Sheng-YenHuang, "2D to 3D Image Conversion Based on Classification of Background Depth Profiles", Springer Y.-S. Ho (Ed.): PSIVT 2011, Part II, LNCS 7088, pp. 381-392, 2011
12. Dun-Long Liu , Zi-Yong Zhou, Qian Wu, Dan Tang, "Symbol recognition and automatic conversion in GIS vector maps", Springer, Cross Mark, Pet. Sci. (2016) , Vol 13, pp -173-181
13. ShubhangiMunde, Tushar A Wagh, TusharBangar, Tushar K Wagh, Akash More, DeepaliGothwal, "Survey Paper on 2D-to-3D Image Conversion Techniques for Multipurpose Imagery", International Journal of Advanced Research in Computer Science & Technology (IJARCST 2015), Vol 3, No 4, 2015, pp 63-64
14. FahriYaras ,Hoonjong Kang, LeventOnural, "State of the Art in Holographic Displays: A Survey", Journal Of Display Technology, Vol. 6, No. 10, October 2010, pp 443-454

November-December 2019
ISSN: 0193-4120 Page No. 6351 - 6355

15. Noel Vincent, Shiny Mathew, Shilu Mathew and IshtiaqQadri," Reconstruction Of 3D Model From 2D Surveillance Images", International Journal of Engineering Research and General Science Volume 3, Issue 5, September-October, 2015, pp 735-744
16. Faisal R.Al-Osaimi, "ANovel Multi-Purpose Matching Representation of Local 3D Surfaces:A Rotationally Invariant, Efficient, and Highly Discriminative ApproachWith an Adjustable Sensitivity", IEEE Transactions On Image Processing, Vol. 25, No. 2, February 2016, pp-658-672
17. MiroslavGalabov," 2D to 3D conversion algorithms", Research Conference In Technical Disciplines, November, 17. - 21. 2014, pp-91-93
HemaliDholariya, JayshreeBorad, Pooja Shah, ArchanaKhakhariya," 2D to 3D Conversion Using Depth Estimation", International Journal of Engineering Research & Technology(IJERT)Vol. 4, No 01,January-2015, pp 329-334.
18. JanuszKonrad, Meng Wang, and PrakashIshwar, "2D-to-3D Image Conversion by Learning Depth from Examples", IEEE, 2012, pp-16-22
19. ShwetaPatil, Priya Charles, "Depth Estimation for 2D-to-3D Image Conversion Using Scene Feature", International Journal on Recent and Innovation Trends in Computing and Communication, Volume: 3 Issue: 6 ,pp-3925 - 3929
20. Nidhi Chahal, MeghnaPippal ,SantanuChaudhury," Automated Conversion of 2D to 3D Image using Manifold Learning",IEEE, 2015, pp-1-4
21. Zhihong Zhang , Xu Chen, Beizhan Wang, Guosheng Hu , WangmengZuo , and Edwin R. Hancock , "Face Frontalization Using an Appearance-FlowBased Convolutional Neural Network", IEEE Transactions On Image Processing, Vol. 28, No. 5, May 2019, pp 2187-2199
22. Yuming Fang , Guanqun Ding , Jia Li , and Zhijun Fang , "Deep3DSaliency: Deep Stereoscopic Video Saliency Detection Model by 3D Convolutional Networks", IEEE Transactions On Image Processing, Vol. 28, No. 5, May 2019, pp-2305-2318
23. Haiyun Guo, Jinqiao Wang, YueGao, Jianqiang Li, and Hanqing Lu, "Multi-View 3D Object Retrieval With Deep Embedding Network", IEEE Transactions On Image Processing, Vol. 25, No. 12, December 2016, pp -5526-5537
24. JackSpencer, KeChen, and JinmingDuan, "Parameter-FreeSelectiveSegmentationWith Convex Variational Methods", IEEE Transactions On Image Processing, Vol. 28, No. 5, May 2019, pp 2163-2172
25. Michael Kampffmeyer , Nanqing Dong, Xiaodan Liang, Yujia Zhang , and Eric P. Xing, "ConnNet: A Long-Range Relation-Aware Pixel-Connectivity Network for Salient Segmentation", IEEE Transactions On Image Processing, Vol. 28, No. 5, May 2019, pp 2518-2529
26. Shouyi Yin, Hao Dong, Guangli Jiang, Leibo Liu, Shaojun Wei, "A novel 2D-to-3D video conversion method using time coherent depth maps", Sensors 2015, Vol 15, pp-15246-15264.