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Review Paper on Techniques of 2D to 3D Image Reconstruction

Himanshu Tanwar[1], Gaurav Kumar[2]
Department of Computer Science, Engineering, Chandigarh University, Punjab, India

Abstract: ***The review paper emphasize on reducing technologies for 2D and 3D imaging, as well as model conversion. Although the popularity of 3D hardware is growing rapidly in the present era, 3D content is still dominated by its 2D counterpart.***
There are two main categories of image processing now available in the market, namely analogue and digital image processing. To produce hard copies such as scanned pictures and printouts, with images being the most common output, the analogue IP technique is used. On the other hand, Digital IP is used to manipulate digital images using computers, the outputs are often information related to images, mainly being data on features, edging characteristics, or masks. Image processing techniques, including Machine Learning and Deep Learning, can get more powerful.
Keywords: Shape from Shading, Morphable, 3D, Face Reconstruction, Image Processing, Structure from Motion

I. INTRODUCTION

The difficulty of reconstructing 3D representation of face from 2D photographs is a key topic in graphics of computer ,with applications such as image processing, a 2D image consists only two dimensions: height and breadth; it lacks depth in face identification and animation. As on loss of data during projection of camera and the requirement of sufficient prior knowledge of 3D shapes, this challenge is extremely difficult. In it.

Therefore, a 2D image can be expressed as function in a plane i.e. f(x, y) , where x and y are coordinates of plane at that point. Intensity or gray level of image at any point in the plain is defined as amplitude of function, f at that couple of coordinates (x, y). Any image is kept in the category of digital when all the pairs of (x, y) are finite and discrete. On the other hand the one that incorporates depth information in addition to height and width. 3D is currently available on TVs, Blu-Ray players, gaming products, smart mobile phones and many other things is known as 3D image. These 3D media create a sense of immersion or a more lifelike viewing experience for the audience.As 3D texture available, on the other hand, does not keep up with its production. To make 3D shape like material, so there are two important methods. The first methodcaptures by cameras is to capture the content directly with several cameras, while the second method is to convert 2D conventional footage to 3D. The former method produces the best results, but it is difficult and expensive to apply since it requires specialized equipment and a powerful production system.

3D imaging is otherwise called as stereoscopy. With the use of binocular vision, this approach is widely applied to create or enhance a 2D image by increasing the appearance of depth. The issue of estimating depth from a single 2D picture, which is the first stage in 2D to 3D translation, may be expressed in a variety of ways, such as a *shape from shading problem*[].

This issue, however, is highly under-controlled; brilliant depth estimates can only be discovered under exceptional circumstances. Given details about lighting, surface resource, and projection of camera, this algorithm is computer insight algorithm, that results in 3D form from shade variations in 2D pictures. These strategies take advantage of the information provided by extrinsic factors such as shade. Other techniques, such as Blanz and Vetter's 3D Morphable Model [] (3DMM), express a linear combination of the sample faces. Due to its simplicity, 3DMM is a common parametric face model that has served as the foundation for more complex face reconstruction approaches. Mostly methods need multiple images for reconstruction which is time consuming and computationally expensive.

So some effective methods are used by researchers.

II. APPLICATIONS

Image processing to create models and images is one of the most rapidly evolving technologies, and it's evolved tremendously over time. It is now employed by a wide range of enterprises and organisations for a wide range of applications. It can be said that now 3D image reconstruction can be used in each and every field. Entertainment is one of applications of image processing. People enjoy 3D movies more than 2D. Today there are many games based on 3D visualisation. Robotics and reverse engineering has also been benefited by image processing.

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Augmented reality has a great future scope and it can be made better by using 3D images and animation. It is used in medical field to increase the quality and quantity of information and makes the content easier to understand. To increase the quality of 3D picture reconstruction, several comparisons of different methodologies have been conducted.

3d image reconstruction has numerous applications in various domains. Some of them are discussed below:

1) *Image Processing:* The foundation, inclination, and canopy type of an effort to consolidate a building footprint.
2) *Multimedia:* Determining structure altitudes and functioning together to improve footprint detection.
3) *Video Technology:* A 3D model reformation of a planar-faced intricate manifold item is constructed from a 2D linear drawing.
4) *Pattern Analysis and Machine Learning*

a) A mesh evolution framework based on a new self-intersection removal technique called TransforMesh.
b) A novel object-based rendering and 3D reconstruction programme is constructed by combining the linear and non-linear morphable neutral face models in an optimization framework. c.) A unique methodology and multiple kinect capturing system for the construction of accurate, realistic.
c) In order to generate the shape and handle patches necessary for a 3D global object, shading information is used in more generic scenarios.

5) *Computer Graphics:* For a scene captured under several unknown illuminations, MVS and photometric stereo are integrated to build watertight 3D reconstructions.

III. LITERATURE REVIEW

John D. Bustard and Mark S. Nixon, 2010, [1] believed in the paper that the human ear can be used to recognize them. This is because it varies crucially between person to person. In a detection algorithm, accuracy and robustness had been improved by using ears in addition with face recognition, especially for non-frontal viewpoints. Face Recognition Grand Challenge dataset was utilised. The model is resistant to occlusion as well as noise. It was achieved by marking areas of the mesh as invalid. The fitting process was not aided by these invalid regions. The labelling is done automatically by a classifier that has been trained. The labelling is done automatically with the help of a classifier that was trained on 30 humanly labelled photographs. To classify the surface, a collection of labelled feature points were used to align and distort the model. The range scan was then approximated by computing the mesh surface points that were closest to the range scan pixels.

The results suggest that the proposed methodology extracts a decent performance linked with an individual's identity. It also displays that the used training samples are approximately attaining model convergence within the registration process' error margins.

Luo Jiang, Bailin Deng, Juyong Zhang, Ligang Liu[8]: used the example-based algorithm to acquire an approximation of the targeted 3d model of face. The prosess started when the input image was attached with example-based parametric face model. Faceware House and the Basel Force Model were used to create the guideline model. Two datasets was used in the paper. Those dataset consisted of 3D face images that had larger diversity in facial expression and recognition respectively. A network model was created, that clearly reflects the target face's largely contour.

- After that, they apply smooth deformation to the coarse face model to capture medium facial characteristics.
- Finally, a height face surface is prosuced depending on the shade variance of the input image, the lighting parameter and the augmented face model.

Yunjie Wu,Zhengxing Sun, YouchengSong,YunhanSun,JinlongSh[], introduce an unique network that successively outputs 2D slices for 3D reconstruction using shared-weight 2D deconvolution. Also a sliceaware attention mechanism was build. It allows a 3D model to bring out all important and relevant information for each and every slice. Finally, the utility of the technique using both synthetic and real data was demonstrated.

Yunjie Wu, Zhengxing Sun, YouchengSong,Yunhan Sun, Jinlong Shi[],introduce the latest 2D-to-3D picture conversion technique that is improved and technically much more efficient. It was discovered by K stereopairs or image + depth pairs whose photometric data is approximately equivalent to that of a 2D interrogation, so that it could be translated from a library of 3D photographs.

Following that, the k matched depth fields are blended, and its depth is aligned with the query of 2D image. XiaoMei Bai and Yang Kuan[] used 3D modeling as the starting point, foundation, and core of virtual reality. In addition to the built-in geometric models, 3DS MAX provides a variety of model creation schemes.

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By default, 3DS MAX models loaded into Unity 3d have a ratio of 0.01:1. It also includes texture map generation, map baking and other features, and can also generate automatic animations, animations and more in virtual reality. File format generated (FBX, 3DS, OBJ in Unity can be read in 3D) and scale factor in Unity 3D.

Meng Yang, Zhen Wang, Shilong Xiao[], The article investigates collision detection and artificial intelligence technology in three-dimensional game technologies, designs three-dimensional game systems, and proposes a collision detection algorithm based on segment detection based on extensive research on various collision detection algorithms. The experiment reveals that the revised collision detection algorithm can successfully decrease system calculation amount and promote operational speed, with calculation amount reduced by 11.85 percent and game operational speed increased by 5.33 percent. The paper proposes a technique for ranking different searched path and brush up the 765 A * algorithm to address most of the shortcomings of high storage capacity, heavy computation each node, and lengthy search time. When the game map is not very complicated, the enhanced method may accomplish optimum path search. According to the testing results, the enhanced. A * path search algorithm may reduce number of visitors traffic by 34.76 percent for inner storage while increasing game rendering frequency by 2.56 percent.

Table

SR. NO	AUTHOR NAME	YEAR	TECHNOLOGY /ALGORITHM	PROS	CONS
1	John D. Bustard Mark S. Nixon	2010	robust registration algorithm	The first entire head morphable design expressly developed to precisely mimic both the facial and ear form.	The examination demonstrates that the provided approach extracts a consistent form connected with the individual's identity.
2	Yunjie Wu Zhengxing Sun Youcheng Song Yunhan Sun Jinlong Shi	2012	simplified datadriven 2D-to-3D conversion	This approach performs well in terms of estimated dept quality as well as computational complexity.	creates a deterministic scene model that considers all conceivable backdrop and foreground combinations
3	Juseung Yun Jaeyoung Lee Dongyoon Han Jeongwoo Ju Junmo Kim	2017	photometric stereo; Morphable model;	By repeating the coefficients acquired following morphing in the 2D picture space, photometric stereo decreases complexity.	Photometric stereo needs numerous photos for each lighting situation and only appears to work with specified limits that are unrealistic for many materials.
4	Swarna Priya Xiao-Zhi Gao	2017	Structure from motion	In SFM algorithms, this factorises the shape and motion components.	Pose rotation constraints are insufficient for achieving reliable 3D reconstructions.
5	Luo Jiang Bailin Deng Juyong Zhang Ligang Liu	2017	Coarse to find method;	In terms of process and maintain and geometric details, our technique outperforms the previous example-based and SFS methods.	Because of the low dimensional model's limited degrees of freedom, these methods frequently fail to recreate precise geometric features.
6	Tao Wu Fei Zhou Qingmin Liao	2017	Shape-from-shading	The entire process is automated and just requires a sole frontal face photograph as input.	Because the process cannot be executed manually, we are unable to include our technique.

7	Xu Chen Qingfeng Wu Shengzhe Wang	2018	Structure from Motion; Multi-View Stereo Poisson; Surface Reconstruction;	It accepts a variety of object views as input.	Manually creating 3D models with modelling tools is time consuming and costly.
8	Indira S.P. Shreedhara K.S.	2018	openGL	Medical imaging has significantly altered patient care routines by providing evidence for diagnosis and increasing therapy efficiency by recognising objects and geometric characteristics.	It is complicated owing of organ topology and data exchange.
9	Kanuengnit Frédéric Vignat Francois Villeneuve	2019	Computer vision systems; computer numerical control (CNC) machine; DEHV-Depth Encoded Hough Voting;	The CNC machine works quickly, accurately, and with little faults.	These aspects are dependent on the researchers' selection of the relevant properties of the item to extract in order to produce the 3D object reconstruct.
10	Yunjie Wu Zhengxing Sun Youcheng Song YunhanSun, Jinlong Shi	2020	Slicenet	Reduces memory usage, allowing for better resolution final outputs.	With a reduced resolution, the model cannot give more believable findings.

Table1. Comparision Table

IV. CONCLUSION

The recent conversion methodology used in reconstruction of 2D pictures and animations to 3D were discussed in this literature study.

Many approaches, such as Shape from Shading, Coarse to Find Method, Slicenet, Robust Registration Algorithm, and 3D Morphage model, can be used to convert (3DMM).

There is an increasing need for 3D content, and these solutions can help bridge the difference among both i.e. 2D and 3D image. Even though the discussed strategies produce positive outputs, there is still scope of development.Every discussed algorithm has its own advantages and disadvantages.

Since the methods discussed in the paper are computer vision algorithms, accomplishment of future hardware to minimize the design metrics for practical implementation and optimization can be researched.

Hence, it is concluded that slicenet is the best algorithm that can be used for transformation 2d images to 3d, because it had less limitation as compare to other methods.

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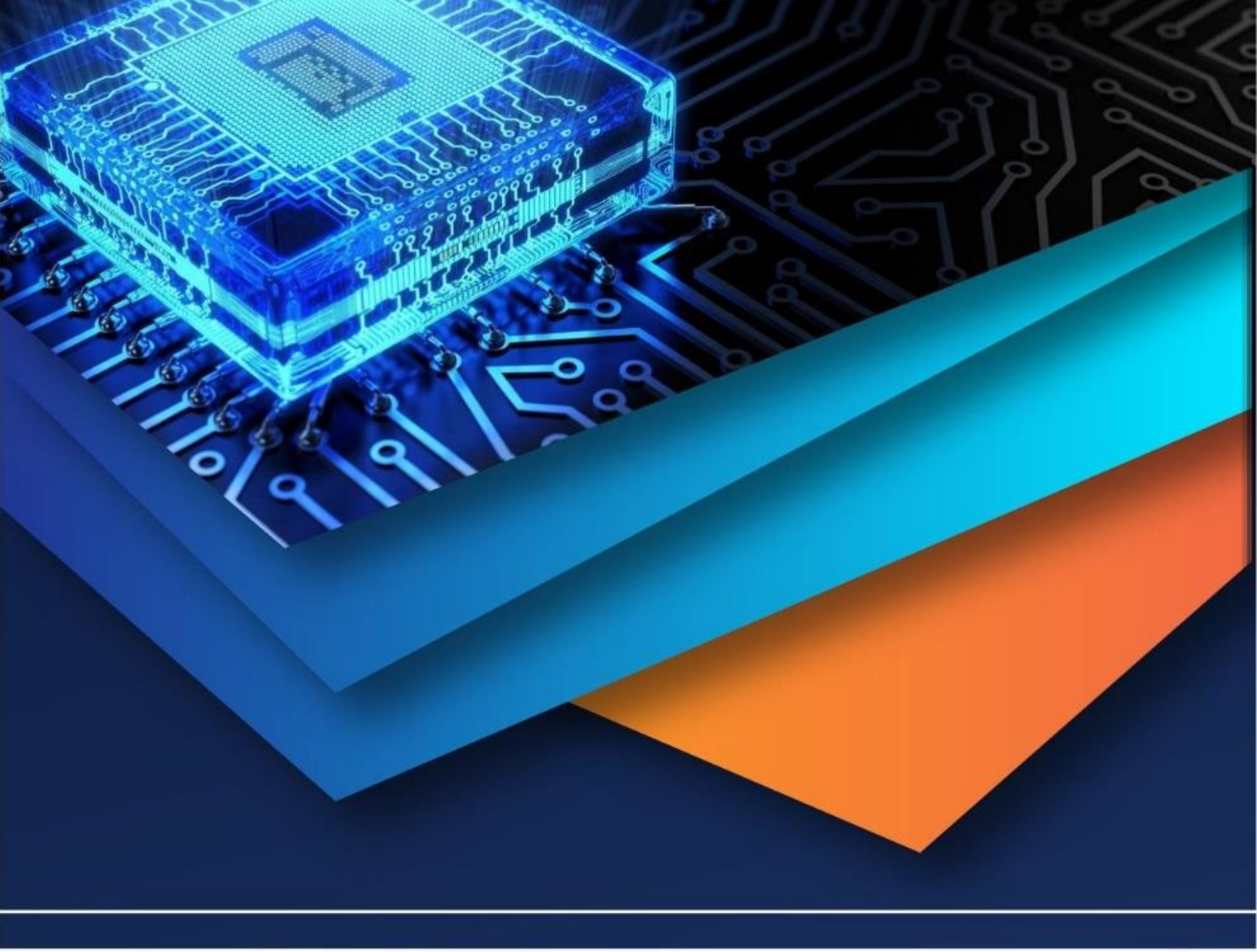
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