Various Methods of 3D Content Generation for Image Processing

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ABSTRACT - 3D is the buzz term used everywhere nowadays. People intent to buy TV's , gaming gadgets ,Cameras, Smart phones which are capable of displaying 3D information. 3D hardware is quiet popular and widely available in market. 3D content development is essential for capturing new data in 3D and also there is a need to convert 2D data available into 3D format for efficient display in 3D hardware. 3D content is used widely in medicine, engineering, earth science, architecture, video games, movies, printing and many more fields. This paper explores various ways to create 3D content using hardware and Software available, 3D datasets available for study and 3D classification.

1. INTRODUCTION

The term stereoscopic vision refers to the human ability to view with both eyes in similar, but slightly different ways. Eyes of any person are a few inches apart and this is called the interocular distance. This allows humans to judge distance, which develops their ability to have true depth perception. For people and animals that have stereoscopic vision, each eye sees a similar, but slightly different image. These positional differences are referred to as horizontal disparities or binocular disparities. The brain processes these images in a way that allows the person or animal to slightly see around an object without having to physically move. This process is accomplished by matching 2 different images and then taking into account the differences in these two images. Although the visual differences are small, the end result is a significantly improved depth perception of one's surroundings.The 3D effect is created by taking two images from two lenses, creating a parallax effect. Parallax occurs from viewing an object along two lines of sight.

2. METHODS TO CREATE 3D CONTENT

A 3D image can be captured directly by using a 3D Camera or we can convert the 2D image using 3D software available. The paper is organised as follows: Section (3) explains the working principles of 3D camera. Section(4) explains the various software available as freeware for converting 2D image into 3D image. This can be used for preliminary study to understand the basics of 3D. Section (5) explains the various file formats used to represent 3D content. Section (6) explains the contents of a 3D file. Popular 3D datasets available for study are listed in Section (7).

3. WORKING OF 3D CAMERA

A 3D camera is an image capturing device that enables the perception of depth in images to replicate three dimensions as experienced through human binocular vision. 3D camera in current scenario are of two types. One with two lenses and two image sensors are available for simultaneous exposure of a stereo pair. The two lenses are set approximately the same distance apart as a pair of human eyes mimicking the sense of depth that we get when we view things with our own eyes. The twin lenses capture two images simultaneously similar to how our right and left eye would see two different images and the 3D processor converts these two images into a single 3D image file. By layering the two 2D images on top of one another, the camera is able to create one single stereoscopic 3D image with depth.These cameras are more expensive due to the additional hardware and limited demand. Panasonic, Fujifilm   and   few   other   brands   markets   double-lens 3D cameras. Fujifilm FinePix Real 3D W3 and Panasonic Lumix 3D1 with 10 and 12 megapixels of resolution are the most popular of 3D cameras available. Recent trend adds 3-D assist capabilities to conventional cameras. The other type made inexpensively by taking two pictures with the same camera, but moving the camera a few inches either left or right. Nikon and Sony 3D cameras allows the photographer to shoot one scene, then shift the camera assisted by a translucent image on the camera display. After the subject is aligned, the camera exposes the second image, using the same exposure and focus.Sony SLT-A58K and DSLR Samsung NX300 with 2D/3D Lens are examples.

Fujifilm Finepix   Panasonic Lumix 3D1
Real 3D W3

It is not the creation of 3D images that is problematic, but more the displaying of them. Today's 3D cameras capture the images and do not perform any of the decoding functions needed to view the photos three-dimensionally. Images taken with any 3D camera can be viewed on a 3D TV, using special 3D prints or on the back of the camera as in Fuji. Active decoding viewing uses battery-powered glasses to sync polarized images with a 3D television. Viewing 3D TV without glasses can be accomplished through the use of lenticular screens, but the field of view for these TVs is limited, and the lenticular screen reduces image resolution. Other method make use of glasses to view the 3D image. Passive decoding technology uses either anaglyphic viewing the red and cyan lensed glasses or polarized viewing, which uses gray lenses with different polarizing directions. Some of the drawbacks include - 3D TVs are expensive; 3D prints are time consuming to produce and expensive; It's not possible to view 3D image on our camera except FujisFinepix. Other challenges are, some of cameras will work only in landscape orientation. Images taken with the camera in a vertical orientation are more difficult as your eyes cannot adjust to the parallax. Images with some depth will work better, for example medium distance photo shots. While others like macro shots, night time images and compositions where the subject is near the edge of the frame will not be as effective.

4. USING SOFTWARE FOR GENERATING 3D CONTENT

There are many 2D to 3D open source convertor software available. The convertor tool adds depth information to the 2D image fed to it. Different algorithms and techniques are used by different convertors to convert a given 2D image into a 3D image. Some of the popular software available are Blender, Make3D, 3DShade, Recap pro, Insight3D, ConvertImage, etc. Some of them are fully automatic, they have programs that automatically estimates depth for an image. Most of the convertors will get a 2D image captured from a normal camera and stored in PC in standard image formats as input and adds depth using various techniques. Others are semi automatic, we have to assign depth to various parts of the image. We need to define few parameters like width, depth, position of object explicitly.

Some software make use of a single 2D image to create its 3D counterpart. The software creates picture of two colours, manipulate the colour mixture and overlaps the two images (same image) that gives us the illusion of depth. Some of them calculates colour intensities in picture and produce depth information with quite accurate perspective. The software also allows us to select tones from hundreds of tones available in their database and render it to our image. The second method is to use series of 2D image of the scene, the software will automatically match them and measure position in space. Some of them are design tools, wherein the user draws the image as object in the screen. The camera angle, directional light are set by default and object is converted into 3D image. Some of standard features includes allows us to customize shade, view or colour special effects like crop, resize, rotate material finishing like wax, sandstone, steel possible to export and import the 3D files.

The software available will convert 2D formats like jpeg, png, gif, bmp, tif, pdf into 3d files. But cannot be guaranteed to achieve complete accuracy. Few 2D photos were taken and converted into 3D using simple to work with 3D softwares.

Figure 4.1 - Original 2D Image

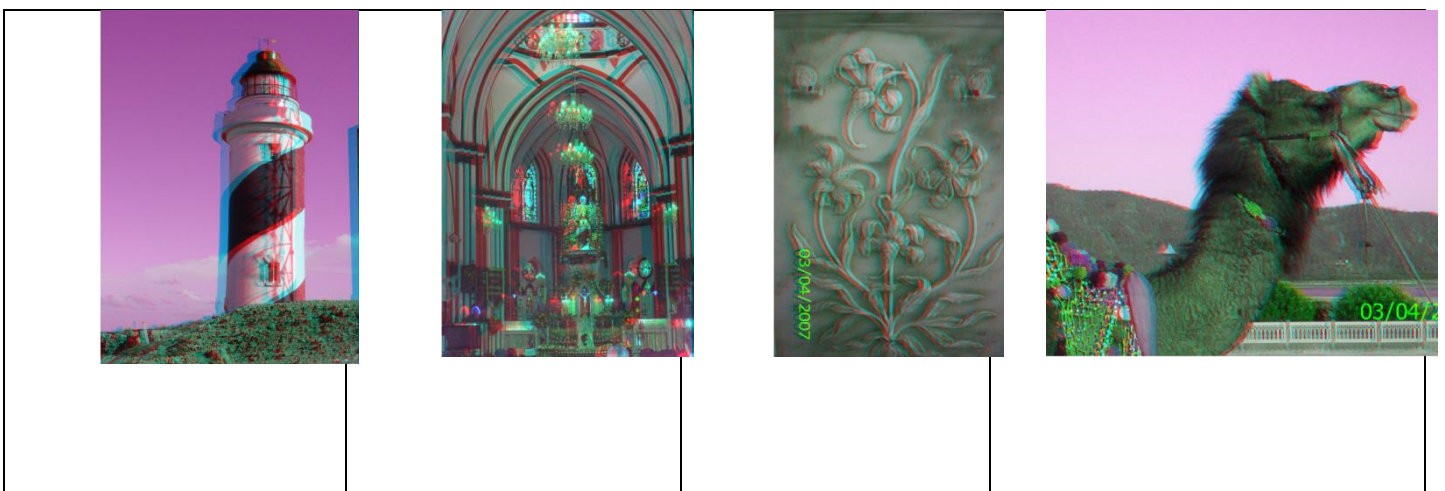**Figure 4.2 - 3D Image using Convert Image Software**

Figure 4.3 - 3D Image using PIC3D Software

Sample Input 2D images are taken and are converted into 3D images using two very simple online softwares, ConvertImage and Pic3D. ConvertImage **turns photographs into 3D anaglyph Stereograms**,.Anaglyph 3D images contain two differently filtered coloredimages one for each eye that **give the illusion of depth**. It is possible to see the 3D stereoscopic image with **a pair of two-tone glasses**. They have to be worn the way that your left eye match the red lens, and your right eye match the blue one. ConvertImage is a very simple to use online software that creates the output in just three steps. Blender and Shape3D can be used when we need 3D models and more precision.

5. FILE FORMATS FOR 3D

3D file formats are used to store information about 3D models, animation and project files. Unlike 2D image files, a 3D image file not only stores pixel values but some additional information are also added. This includes geometry, appearance and information about the scene. 3D models are typically comprised of polygons and vertices that create the models shape. They also include information about texture, lightning and shading . Table 4.1 list some of popular 3D image formats available. Most of the 3D formats are optimized for use on the specific software alone. Different formats stores different attributes about the image. Therefore difficult to exchange files and view them on different software. 3D image created using one software cannot be viewed using another software. .BLEND file created by Blender cannot be viewed using AutoCad software. Some open source formats to solve this interoperability problem are also available. Neutral formats like STL and COLLADA (.STL and .DAE extension respectively) may be used to exchange and view the 3D models. First convert 3D file into .DAE file and export it. Use other 3D software and import the .DAE file and convert them into the software's respective format.

Table 5.1

File Extension	File Type
.3D,.3D2,.3D4	Stereo CAD-3D image file
.3DM, .3DX	Rhino 3D model file
.3DMK	123D Make project file
.3DP	123D catch photo file
.3DV	3D VRML file
.ANIM	Maya animation file
.ANM	3D animation file
.BLEND	Blender 3D data file
.C3D	C3D model file
.D3D	Game maker 3D file
.MESH	3D mesh model
.OBJ	Wavefront 3D object file
.P3L,.P3M,.P3R	Adobe Photoshop setting file
.STC	Manga studio file
.U3D	Universal 3D file
.X3G	3G print file

6. 3D FILE CONTENT

What does a 3D file contains? is an important thing we need to know before handling them. The content of a 3D file can be classified into three categories- such as geometry, appearance and scene information.

6.1 Geometry

The geometry of a model is stored as a set of 3D points. There are various ways to represent surface information of a 3D image. A set of Polygons may be used to represent the surface of the model . These polygonal meshes are convenient and quick to render 3D content. This method is very simple and is widely used in 3D printing. Here use of more vertices yields better results but this may lead to larger storage space. Use of polygons not feasible for smooth surfaces. We can use Non uniform Rational B-spline patches to create smooth surfaces. Here, a number of control points each with its own weights and parameters known as knots are stored. We can easily edit the 3D model because we need to work only with control points to achieve transformation in a particular part of an image. But, the method is quiet time consuming. Now the latest method is to use constructive solid geometry, CSG. All the image elements are not treated as the same. Instead assign different 3D shapes to different objects based on their appearance. Simple primitive shapes like cylinder, sphere and cubes are taken and boolean operations like addition and subtraction are performed to built 3D shapes. We must save each of the operations and shape information for future editing. Conversion from CSG format to other mesh

type formats is a challenging task and is a subject under study. Constructive solid geometry is a user friendly and time saving method.

6.2 Appearance

Assigning texture to the surface of the model is more important, as in 3D we need to have a feel of the model. The texture and color for each vertices (or) knots (or) shapes need to be assigned by mapping each 3D vertex to a corresponding point in the 2D image. Light source plays a vital role in the appearance of an object. Colour of the object we perceive depends on the light source. Most of 3D file formats support texture mapping. The extra information may be stored in the same file or in a separate file.

6.3 Scene

Layout of the 3D model with respect to camera, light source and nearby objects is referred as the scene information of the 3D image. The direction of camera, its magnification, principal point and up direction are needed to define the view of the camera. In order to define the scene the position of the light source, its intensity and colour need to be known. A single 3D image may have several parts. In such case we need to know how to layout the several parts and separate transformation matrix for each part need to be stored. Most of 3D file formats currently available does not support scene information.

7. 3D DATASETS

Machine learning techniques are widely used for various application nowadays. Deep learning has gained more attention in various research domains such as speech recognition, computer vision and image analysis. High level machine learning API which makes training and evaluation very easy are readily available. 3D data evaluation and classification are quiet popular now. Apart from creating our own datasets we can readily use the datasets available in the Internet. Since creation of dataset- taking the pictures, labelling and extracting features take long time and effort, we can easily make use of available datasets. Some of the popular datasets available are: 3D MNIST, Kaggle, CVOnline, ObjectNet 3D, MS-COCO, UCF 101, ImageNet, OpenImages.

8. CONCLUSION

3D technology in near future will be a very common application in many fields .For that a basic understanding of 3D data characteristics, 3D file formats, 3D generation methods become essential. The recent technological improvement under development being using plastic films placed over the normal LCD screen, iPad, Laptop (or) Desktop. With this technique we can have glasses free 3D display. The product works with downloadable software application that converts image into stereoscopic views. This paper presents a basic idea of 3D data content creation, 3D file formats available ,basic attributes used to store 3D data and the popular 3D datasets available.

9. REFERENCES

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