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3D Holoscopic Image Video Content Display on Volumetric Displays: The next generation 3D TV technology

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ABSTRACT

Integral imaging, also known as Holoscopic imaging to be promising approach for glassless 3D and Its methodology uses the principle of "Fly's eye" and hence allows natural viewing of objects (i.e. fatigue free viewing), In this paper, the main objective is to provide a new plug-in tools for full parallax computer generated 3D Holoscopic content, based mainly on 3D Virtual Reality Modeling Language parser to enable 3D integral images content and rendering to be produced from VRML file format, and displayed on auto-stereoscopic. In the proposed system, the 3D content is either captured by a single camera with a micro lens, cylindrical lens array or computer generated to allow for mixed 3D video generation. Multiprocessor ray tracing system is adapted to be able to generate 3D integral images that containing 3D IIVRML integral images content parser modules; new 3D IIVRML file format is created by uses 3D unidirectional camera parameters in order to import/accept into ray tracer renderer software. Experimental results show validation of the new plug-in software tool and tests on such *Tie scene* and *Cessna scene* . Consequently, 3D integral images frames and short time *3D II movie* are generated and displayed without a glass on *PC* screen, *LCD* and the HoloVizio.

Keywords: *Computer graphics, 3D Integral Images Generation & Rendering, Multiprocessor Ray Tracing system, 3D IIVRML content parser, 3D TV, 3D camera model*

1. INTRODUCTION

In this new developed tool, virtual reality modeling language is used to describe 3D shapes and interactive environments; the 3D VRML file format is adapted and then converted to be imported / accepted by Multiprocessor ray tracing system [1], to computer generation 3D integral images sequence of frames animation see Fig. 1 A complete plug-in software tool that implements the application programming, interface 3D VRML modelling in the environment of Object-Oriented Programming is developed and the second based is Multiprocessor ray tracing system Tachyon [2] is adapted in order to incorporate a 3D integral Camera see Fig. 1 and 2. The new 3D VRML content parser plug-in is developed to deal with each node of the VRML file format as a token and extract the information that hold, all the data of the 3D VRML scene must be parsed and rendered into multiprocessor ray tracing software adapted Tachyon[1, 2].

2. COMPUTER GENERATED 3D INTEGRAL IMAGES

Integral imaging is attracting a lot of attention in recent year and has been regarded as strong candidate for next generation 3D TV [2, 8]. Computer generation of integral images has been reported in several literatures [9, 17]. A computer generated synthetic 3D integral image is presented as a two dimensional distribution of intensities termed a lenslet-encoded spatial distribution (LeSD), which is ordered directly by the parameters of a decoding array of micro lenses used to replay the three-dimensional synthetic image. When viewed, the image exhibits *continuous* parallax within a viewing zone dictated by the field angle of the array of micro-lenses. The replayed image is a volumetric optical model, which exists in space at a location independent of the viewing position. This occurs because, unlike stereoscopic techniques, which present planar perspective views to the viewer's eyes, each point within the volume of a 3D integral image is generated by the intersection of ray pencils projected by the individual micro-lenses.

Due to the nature of the recording process of 3D integral image, many changes to the camera model used in standard computer generation software are carried out. To generate a unidirectional 3D integral image using a lenticular sheet, each lens acts like a cylindrical camera. A strip of pixels is associated with each lens forming a micro-image. Each cylindrical lens records a micro-image of the scene from a different angle as shown in the Fig. 1 and 2. For micro-lens arrays each lens acts like a square or a hexagonal camera depending on the structure of the lenses, as shown in Fig. 1. In the lateral cross section of the lenticular or the micro-lenses, a pinhole model is used. In the case of lenticular sheets, the pinhole forms a straight line parallel to the axis of the cylindrical lens in the vertical direction. For each pixel, a primary ray is spawned. The recording path of the primary ray draws a straight line going forward towards the image plane and backward away from the image plane. Similar primary rays of neighbouring lenses are spawned to similar directions parallel to each other. Therefore highly correlated micro-images are produced which, is a property of 3D integral images. The structure of the lenses and the camera model in the in 3D Integral images computer graphics affects the way primary rays are spawned as well as the spatial coherence among them.

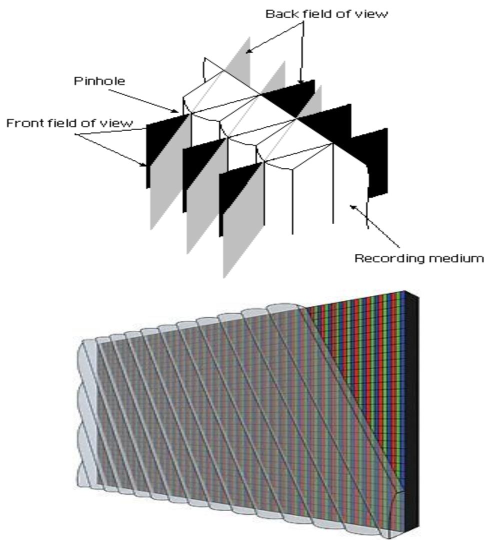

Fig.1 Lenticular sheet model in integral ray tracer

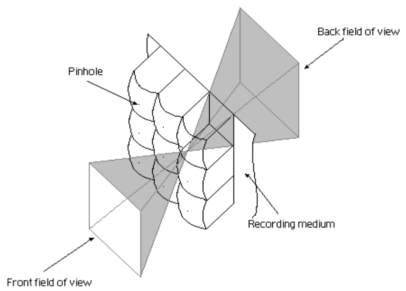

Fig.2 Micro-lens array in integral ray tracing.

3. PLUG-IN TOOLS

The main aim is, how to accept/import 3D VRML model file format and generate a 3D integral images, new plug-in software is developed to allow interfacing the computer generation of 3D Integral images graphics software with only virtual reality modelling language see Fig. 3, 4, and 5 . In the proposed technique, plug-in tools cannot be generated and displayed 3D integral images unless 3D IIVRML modelling parser is developed to parse the 3D modelling into multiprocessor ray tracing as a result, 3D IIVRML content parser is mainly used as a chain between raw data image and the multiprocessor ray tracer renderer system "adapted Tachyon". To capture the rendered frames, attempts are made to write a software to screenshot the scenes and save each frame of them in a separate file so that the files become containing all the frames, and the frames are saved in these files with names of sequenced numbers. This will make it easy for QuickTime to form a movie with them displaying a continuous series of images with the rate of 24 images per second. As a simple example, a simple animated scene was imported from Vrml and rendered after passing it frame by frame through a virtual lenticular lens array, the resulting frames were collected and displayed in sequence as a short movie with Windows Live Movie Maker and displayed on the normal PC screen. The movie can be scene with a 3D effect using a lenticular sheet placed on the PC screen.

A complete animated 3D Vrml scene with many details and objects was produced using a developed Multiprocessor ray tracing system software so that the 3D scene can be imported from 3D Vrml all the way to QuickTime and rendered with its 3D effect in a relatively short time applying just one or few clicks. An example of several frames of a 3D integral images animation of *Tie scene* and *Cessna* are shown in Fig. 4, 5. In this case a cylindrical lens array with 64 lenslets each having 8 pixels is used.

4. STRUCTURE OF 3D INTEGRAL IMAGES VRML FILE FORMAT

VRML is a text file format for describing 3-D shapes and interactive environments on the web. VRML files contain: The file header *Comments* - notes to yourself *Nodes* - nuggets of scene information *Fields* - node attributes you can change *Values* - attribute values *Node Names* - names for reusable nodes more. . . Nodes, fields, values, etc. that describe a 3-D worldShape nodes describe: *geometry* - form, or structure *appearance* - color and texture Shape {geometry … appearance . . .}

```
CAMERA
FOCALLENGTH  5.24
LENSPITCH  1.24
LENSPIXELS  16
APERTUREDISTANCE  1.5
SIZE  10.0
ZOOM  1.0
ASPECTRATIO 1.0
ANTIALIASING 0
RAYDEPTH  4
CENTER    0.0 0.0 -6.0
VIEWDIR   0.0 0.0 1.0
UPDIR     0.0 1.0 0.0
END_CAMERA
Group { children [
Shape {
appearance Appearance {
material Material { diffuseColor 0.266667 0.14902 0.14902
specularColor 0.498039 0.498039 0.498039
emissiveColor 0 0 0 shininess 0.078125 transparency
0.000000} }
geometry IndexedFaceSet {
solid FALSE creaseAngle 0.785398
coord Coordinate {
point [-0.0798857 -0.185478 0.237508, -0.0798857 -0.185478
0.20864,
……..
}
```

Fig.3 New 3D Vrml file format for computer generated content of 3d integral images

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5. VRML 3D INTEGRAL IMAGES CONTNT PARSER PLUG-IN FOR MULTIPROCESSOR RAY TRACING SYSTEM

The main aim is to develop a 3D model parsing software to parse and deal with 3D Vrml model file format into Multiprocessor ray tracing system model because the parallel ray tracer is an open-source ray tracing renderer which is used to develop unidirectional and omnidirectional camera module of integral imaging camera. In the proposed system, 3D Vrml content parser method used to parse 3D Vrml modelling file formats into Multiprocessor ray tracing model. 3D model file is imported / exported and gets rendered as integral image content.

Parsing processes is consisted of three main phases:

- Reading 3D VRML model content file.
- Converting 3D IIVRML model to multiprocessor ray tracing system.
- Rendered the new 3D IIVRML scene description model on multiprocessor ray tracing engine.

The proposed technique is used 3D Vrml models as shown in Fig. 4 , as a raw image data that must be modified by adding 3D unidirectional camera parameters to 3D IIVRML file format shown in Fig. 3 . The main purpose of *3D VRML II* Parser is to extract the file format data and use it as input into and Multiprocessor ray tracing, the output of this process is to generate sequences of frames 3D integral image as shown Fig. 5. The scene description file format, which is usually in the form of a stream of characters. Each token consists of one or more characters stream of characters that are collected into a unit before further processing or parsing takes place. A plug-in algorithm has been developed in order to convert the 3D Vrml model content into the right format without losing of information so that it can be displayed by commercial auto-stereoscopic displays. In this paper a unidirectional integral images camera model is adopted. A file format of a *3D* content parser using multiprocessor ray tracer is shown in Fig. 3. *711* frames have been generated with image size *512 × 512*, and *8* pixels behind each cylindrical lens. An example of the output of this approach is shown in Fig. 5. A 3D model is generated using the 3D Vrml language which is then converted into the multiprocessor model. A virtual 3D Integral camera is used to generate 3D images. A pixel mapping software tool has been developed to provide a unidirectional 3D integral image.

6. EXPERIMENTAL AND RESULT

The results are extremely satisfactory and for the first time it is proved that 3D VRML model can be converted to proper new file format see Fig. 3, then is prepared to parse the 3D vrml integral images (Holoscopic) content can be generated through multiprocessor/parallel ray tracing system and displayed on commercially available multi-view auto-stereoscopic display. In this paper a unidirectional integral images camera model is used. An example of *3D Tie* and *Cessna* scenes are rendered using the multiprocessor integral imaging ray tracer "Adapted Tachyon" is shown in Fig. 4 and 5.

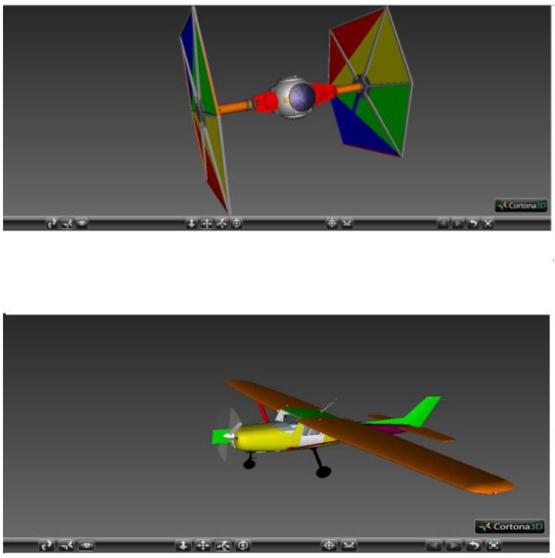
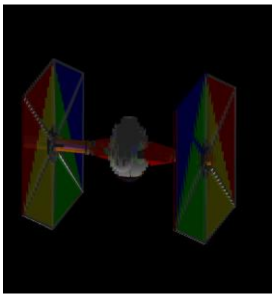
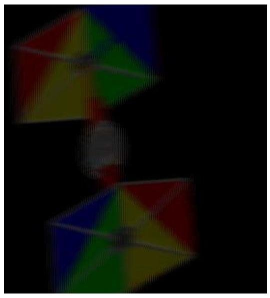


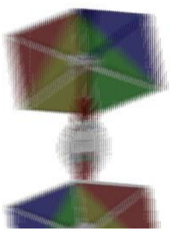
Fig.4 Tie and Cessna scenes are generated by VRML and Displayed by 3D Cortona



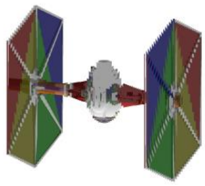
3D integral image of Tie scene frame.0000



3D integral image of Tie scene frame.0399



3D integral image of Tie scene frame.0499



3D integral image of Tie scene frame.0612

Fig.5 Computer Generated 3D integral images frames from vrml Tie scene model after converted to 3D integral images

7. CONCLUSIONS

A 3D Holoscopic image is recorded in a regular block pixel pattern. The planar intensity distribution representing a 3D Holoscopic image is comprised of 2D array of M×M micro-images due to the structure of the microlens array used in the capture and replay. This paper presents an new plug-in software tool to allow a computer generation of 3D IIVRML modelling to be displayed on multi-view auto-stereoscopic. An new 3D IIVRML content parser is developed. In conclusion, we are able demonstrate sequence of frames and QuickTime VRML 3D integral images movie.

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