New 3D Holoscopic Images Content Format

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***Abstract*— 3D Holoscopic imaging (also referred to as Integral Imaging) is a technique for creating full colour 3D optical models that exist in space independently of the viewer. In this paper, the main objective is to provide new file formats as raw material for full parallax computer generated 3D Holoscopic content, based mainly on Adapted Multiprocessor Ray Tracing System, displayed on auto-stereoscopic. The most important is being 3D model file format as there are many 3D modelling application available in the market and support different file formats. Therefore a file formats (scene description file) are developed for an Adapted Multiprocessor Ray Tracing System "Tachyon" (AMRTST) and for Ac3D computer graphics software package as well; the new file formats are created by uses 3D unidirectional camera parameters. Experimental results show validation of the new algorithm (AMRTST) and for the first time a 3D content of file formats are developed, and tests on an adapted Multiprocessor ray tracing system and on Ac3D package some scenes are tested such as teapot, car, roses and human-body.**

Keywords-component; Computer graphics; 3D Integral Images content File Format & Generation; Multiprocessor Ray Tracing system; Ac3D; 3D TV

I. INTRODUCTION

In this new developed Tachyon and Ac3D file format used to describe 3D shapes and interactive environments of the module; and to be accepted by adapted Multiprocessor ray tracing system, to computer generation 3D integral images sequence of frames animation [3][4]. the new algorithm implemented the environment of Object-Oriented Programming in C++ and C programming language and the second based is Multiprocessor ray tracing system is adapted [1][2]. Integral imaging is attracting a lot of attention in recent year and has been regarded as strong candidate for next generation 3D TV [1-8]. Computer generation of integral images has been reported in several literatures [1-14]. A

II. COMPUTER GENERATED 3D HOLOSCPIC IMAGES.

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 Figures. 1, 2 and 3. For micro-lens arrays each lens acts like a square or a hexagonal camera depending on the structure of the lenses, as shown in Figure. 4. 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 neighboring 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.

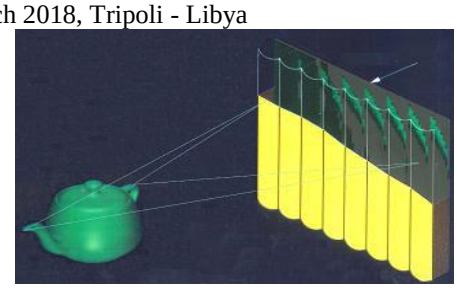


Figure 1: Unidirectional 3D Holoscopic Display.

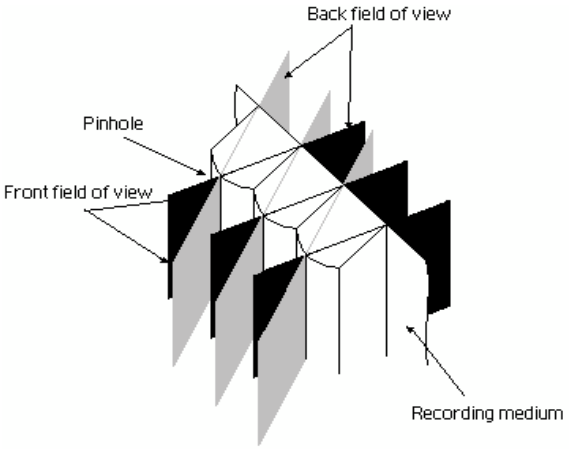


Figure 2: Lenticular sheet model in integral ray tracer.

Figure 3 (a): Teapot scene [3].

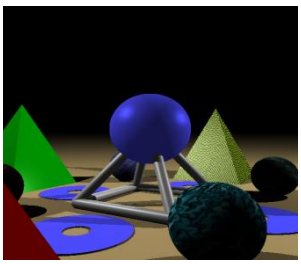


Figure 3 (b): Primitive scenes [3].

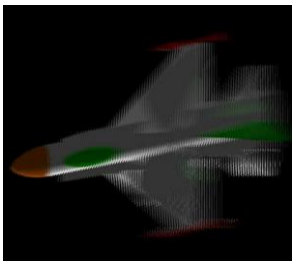


Figure 4 (a): 3D Integral Images frame of falcon scene [1].

Figure 4 (b): An electronically captured unidirectional integral image[10].

The structure of the lenses and the camera model in the in 3D Integral images computer graphics affects the way primary raysare spawned as well as the spatial coherence among them.

III. New File Formats Description For Scnec And Camera

In The adapted multiprocessor ray tracer file Every scene description file must begin with the 3D-Model keyword, and end with the END SCENE keyword. All definitions and declarations of any kind must be inside the 3D-Model, END SCENE pair. The START-CAMERA, RESOLUTION and LENSPITCH keyword are followed by an x resolution and a y resolution in terms of pixels on each axis end with END-CAMEAR see figure 5.

One of the most important parts of any scene, is the camera position and orientation. Having a good angle on a scene can make the difference between an average looking scene and a strikingly interesting one [1][3][9]. There may be multiple camera definitions in a scene file, There are several parameters that control the 3D Integral holoscopic camera, FOCALLLENTH, LENSPITCH,ZOOM, ASPECTRATIO, ANTIALIASING, CENTER, RAYDEPTH, VIEWDIR, and UPDIR.

In order to generate several 3D integral imaging frames animations, a 3D camera file is designed for each 3D description scene model. Basically, 3D camera file is required to manipulate 3D camera viewing parameters in order to have a new position of the 3D integral imaging camera. *3D IIP* is especially developed in order to read the 3D model file format. This section of the paper describes the 3D model file format that has been designed forms the input to the 3D integral imaging parser. The 3D description scene always starts with a header line 3D-Model. The basic structure is %f indicates a floating point value, %d an integer value and %s a string must be surrounded by quotes “if it contains spaces, see Figures 5 to 6.

```
3D-Model
begin_scene
   resolution    %d    %d
START-CAMERA
    FOCALLENGTH    %f
    LENSPITCH    %f
    LENSPIXELS   %d
    APERTUREDISTANCE  %f
    SIZE          %f
     ZOOM         %f
     aspectratio    %f
     antialiasing   %d
     raydepth       %d
     CENTER       %f    %f    %f
     VIEWDIR      %f    %f    %f
      UPDIR        %f    %f    %f
END_CAMERA
MATERIAL  %s  rgb  %f  %f  %f    amb  %f  %f  %f
emis %f %f %f
spec %f %f %f  shi  %d  trans  %f
OBJECT    %s
              name   %s
       data   %d
              texture   %s
              texrep   %f   %f
              rot   %f   %f   %f   %f   %f   %f   %f   %f   %f
              loc   %f %f %f
              url   %s
              numvert   %d
                            numvert lines of    %f   %f   %f
              numsurf   %d
```

Figure 5: new generated Ac3D model file format.

```
3D-Model
begin_scene
   resolution    %d    %d
START-CAMERA
     FOCALLENGTH    %f
     LENSPITCH    %f
     LENSPIXELS   %d
     APERTUREDISTANCE  %f
     SIZE           %f
      ZOOM         %f
      aspectratio    %f
      antialiasing   %d
      raydepth        %d
      CENTER       %f    %f    %f
      VIEWDIR      %f    %f    %f
       UPDIR         %f    %f    %f
END_CAMERA
BEGIN_SCENE
RESOLUTION 1024 1024
...
... Camera definition..
...
... Other objects, etc..
...
END_SCENE
```

Figure 6: New generated Multiprocessor ray tracing model file format.

3D-Model

Specifies the start of scene description file.

begin_scene

Specifies the start of scene description file.

resolution %d %d

The resolution token is followed by an *x* resolution and a *y* resolution in terms of pixels on each axis. There are currently no limits placed on the resolution of an output image other than the computer's available memory and reasonable execution time.

camera-start

Specifies the start of 3D integral imaging camera model description.

FOCALLENGTH %f

The focal length token controls the distance from the lens at which those objects must be kept.

LENSPITCH %f

The lens pitch tells the ray tracer the lens pitch of cylindrical lens

LENSPIXELS %d

The lens pixels token tells the ray tracer the number of pixels behind each cylindrical lens.

APERTUREDISTANCE %f

The aperture distance token controls the distance form the cylindrical towards the aperture.

SIZE %f

The size token controls the size of 3D integral image

ZOOM %f

The zoom token controls the camera in a way similar to a telephoto lens on a standard camera.

aspectratio %f

The aspect ratio token controls the aspect ratio of the resulting image. By using the aspect ratio parameter, one can produce images which look correct on any screen.

antialiasing %d

The antialiasing token controls the maximum level of super-sampling used to obtain higher image quality. The token given sets the number of additional rays to trace per-pixel to obtain higher image quality.

raydepth %d

The ray depth token tells the ray tracer what the maximum level of reflections, refractions, or in general the maximum recursion depth to trace rays to.

CENTER %f %f %f

The CENTER token or parameter is an (*X, Y, and Z*) coordinate defining the centre of the camera also known as *the Centre of Projection*.

VIEWDIR %f %f %f

The VIEWDIR token or parameter is a vector indicating the direction the camera is facing.

UPDIR %f %f %f

The UPDIR token or parameter is a vector which points in the direction of the "*sk*y".

END_CAMERA

Specifies the end of 3D integral imaging camera model description. Generally, the tokens are case-sensitive. Single lines describing a material are referenced by the "mat" token of a surface. The first "MATERIAL" in the file will be indexed as zero. The materials are usually all specified at the start of the file, immediately after the header.

amb

Ambient colour works with the diffuse to affect the overall colour of a surface.

emis

Emissive setting this can make a surface appear to be giving off light.

spec

The specular quality defines the colour and brightness of highlights. This works in conjunction with shininess.

shi

Shininess a high value means that highlights will be smaller and less scattered across the surfaces.

trans

Transparency can be useful for making a surface look like glass.

OBJECT %s

Specifies the start of an object. The end of the object section must be a 'kids' line token which indicates how many children objects may be zero follow. The parameter is the object type i.e. -one of: world, poly, and group.

name %s

data %d

object data. Usually the object-data string for an object. The parameter is an integer which specifies the number of characters starting on the next line to be read.

texture %s

Default is no texture. Graphical images can be mapped onto the surfaces of an object. The images are usually from graphics files such as gif, jpg, bmp etc.

texrep %f %f

Default 1.0, 1.0. The texture repeat values for the tiling of a texture on an object's surfaces.

rot %f %f %f %f %f %f %f %f %f

The 3x3 rotation matrix for this objects vertices. The rotation is relative to the object's parent i.e. it is not a global rotation matrix. If this token is not specified then the default rotation matrix is 1 0 0, 0 1 0, 0 0 1

loc %f %f %f

The translation of the object. Effectively the definition of the centre of the object. This is relative to the parent - i.e. not a global position. If this is not found then the default centre of the object will be 0, 0, and 0.

url %s

The url of an object - default is blank.

numvert %d
numvert lines of %f %f %f

The number of vertices in an object. The parameter specifies the number of lines that follow. If this token is read then that many lines must be read of (%f %f %f) - specifying each vertex point as a local coordinate. Some objects (e.g. groups) may not have a numvert token.

numsurf %d

The number of surfaces that the object contains. The parameter specifies the number of subsections that follow - each one being a different surface

SURF %d

The start of a surface. The parameter specifies the surface type and flags. The first four bits flags & 0xF is the type 0 = polygon, 1 = closed line, 2 = line. The next four bits flags >> 4 specify the shading and back face. bit1 = shaded surface bit2 = two sided.

mat %d

The material. The surface has a material attribute, which defines the colour and quality for lighting purposes.

```
refs %d
   refs lines of    %f    %f    %f
```

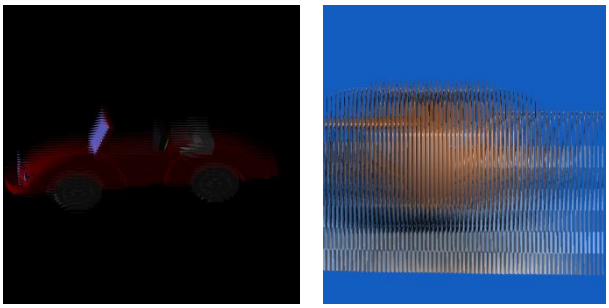
The number of vertices in the surface. This number indicates the number of lines that follow. Each line contains an index to the vertex and the texture coordinates for this surface vertex.

```
kids    %d
```

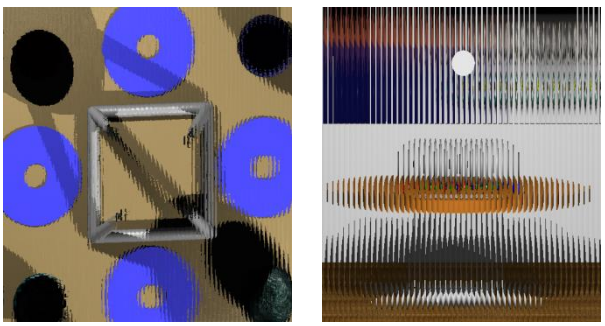
This is the final token of an object section and it must exist. If the parameter is a number grater than 0 then more objects are recursively loaded as children of the current object.

IV. Experimental And Result

The results are extremely satisfactory and for the first time it is proved that content file formats can be generated through multiprocessor/parallel ray tracer and displayed on commercially available multi-view auto-stereoscopic display. In this paper a unidirectional integral images camera model is adopted see figure 7.



(a): car scene. (b):teapot scene.



(a): primitives scene (b):room scene.

Figure 7: car, teapot, primitives and room scenes are generated by 3D integral multiprocessor ray tracing system,(adapted Tachyon). [3][10][16].

V. Conclusion

Integral Images is able to provide data that reconstructs a 3D image exhibiting continuous parallax within the viewing zone. The advantages of Integral Images are the single aperture camera, full colour and true scale image. This paper presents a new file formats based on the Multiprocessor ray tracing system. In order to enable the Multiprocessors ray tracer to read the file format without losing information of the 3D integral images content.

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