ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering
(IJERCSE)
Vol 5, Issue 1, January 2018

Depth Image Based Rendering For 3D TVs

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Abstract:This paper provides descriptions of a system which allows an evolved depth perception to be integrated into the current 2D digital TV environment.The work is part of "Advanced ATTEST or the three-Dimensional Television System Technologies project of the EIST or European Information Society Technologies that is an initiative in which companies, research institutions and various universities have joined the forces to develop the backwards compatible, scalable and functional 3D-TV broadcast system.Generation as well as the distribution of a novel data display format, consisting of a monoscopic color video and an associated perpixel depth information is at the very core of new concept described herein. Through these depth-image-based rendering techniques, one or more than one "virtual" views of an actual-world scene can be formulated from these data in real-time at the side of receiver.This publication provides a detailed overview of the fundamentals of the new approach on 3D-TV, compares with the classically known approach to stereoscopic video, briefly introduces DIBR techniques in general, creates a particular DIBR algorithm which can be used to efficiently produce "true" stereoscopic views of the highest quality;

Keywords: Depth image based rendering, 3D television, system, television, ATTEST, EIST.

INTRODUCTION

Building on these patterns, the ambitious goal of the European IST project [1]ATTEST's is to develop a new, backward-compatible and scalable 3D-TV[2] broadcast system.Unlike previous propositions that often relied on the fundamental concept of “stereoscopic” video that is, to capture, to transmit and to display two separate video streams, one for the left and another for the right eye, this research is based on a much more efficient joint transmission of the monoscopic video color and related per-pixel depth data.

Using the so-called depth-image-based rendering (DIBR) [3]techniques, multiple "virtual" views of a real-world scenes can then be created in real-time at the side of a receiver from this type of data representation.The proposed modular architecture of a system provides various important advantages, such as backward compatibility with today's 2D digital Television, scalability in terms of the receiver complexity as well as adaptability to a wide range of 2D[4] and 3D displays.

The envisaged signal processing and the data transmission chain of the ATTEST 3D-TV paradigm is outlined in Figure 1 below to enable for an improved understanding of the key ideas. 1. Four separate functional building blocks are comprised in this: 1) 3D content creation; 2) 3D video coding; 3) transmission and 4) generation of "true" view and the 3D display.

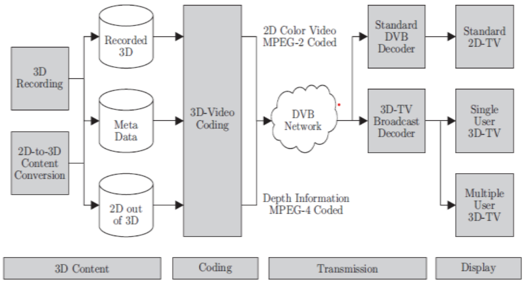

Figure 1: ATTEST’s chain of signal processing and data transmission

For future 3D content generation, two integral methodologies are envisioned. In the main case, novel three-dimensional material is made by all the while catching video and related per-pixel depth data with a functioning extent camera, for example, the supposed Zcam [5] created by 3D-TV Systems. Such gadgets generally coordinate a rapid beat infrared light source into a traditional communicate TV camera and they relate the hour of trip of the produced and reflected light dividers to coordinate estimations of the profundity of the scene. In any case, it appears to be certain that the requirement for adequate top notch, three-dimensional substance can just halfway be happy with new accounts. It will in this way be fundamental – particularly in the basic period of the new communicate innovation – to likewise change over previously existing 2D video material into 3D utilizing supposed "structure from movement" algorithms.On guideline, such (disconnected or on the web) techniques process at least one monoscopic shading video groupings to: (a) set up a thick arrangement of picture point correspondences from which data about the account camera just as the 3D structure of the scene can be inferred, or (b) surmise inexact profundity data from the general developments of consequently followed picture segments.

In the end, whatsoever approach to 3D content generation is being used, the output in all cases is standard 2D color video in the format of European digital TV and a corresponding depth-image series with similar spatio-temporal resolution[6].Each one of these depth images store the depth information as 8-bit gray values with 0 indicating the farthest value and 255 indicating the nearest value (as shown in Figure 2).

In order to convert this data interpretation format into real and metric depth values that are required for generating "virtual" views and to be versatile with respect to the 3D scenes having different depth characteristics, the gray scale values are normalized into two main planes for depth clipping.

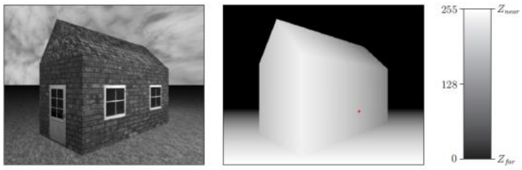

Figure 2: ATTEST's data representation format

SHIFT SENSOR ALGORITHM FOR STERIOSCOPIC IMAGE CREATION

The next section describes in detail how to effectively produce stereoscopic images from a monoscopic color video[7] and related per-pixel depth information through a slightly modified version of the three dimensional warping equation. The best way to get started with this clarification is to have a look at two different configurations commonly used in "true" stereo cameras of high quality.

As presented in Figure 3, all the setups consist of a camera pair that is segregated by the so-called interaxial gap tc as one for the left side-eye view and another for the right side-eye view. However, the main difference between the two designs depends on the method applied to establish the well-known zero-parallax setting (ZPS)[8], i. e. The part of a 3D scene which will be entirely and clearly reproduced on a video screen.

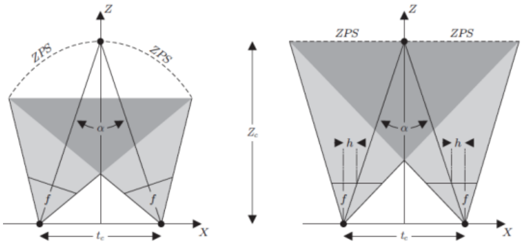

Figure 3: Different types of stereoscopic camera setups

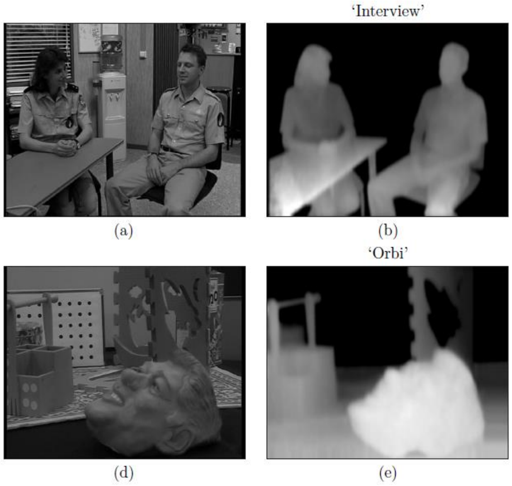

Figure 4: Illustration of "interview" and "orbi" test sequences

THREE DIMENSIONAL CODING

For providing the potential 3D-TV viewers with the three-dimensional (3D) content, firstly, the monoscopic color picture and the related per-pixel depth details are compressed and then distributed over the traditional two dimensional digital TV broadcast infrastructure.

To ensure the correct backwards compatibility with the existing 2D-TV set-top boxes, the basic two dimensional color content must be encoded through the standard MPEG-2[9] methods currently needed by the European Digital Video Broadcast (DVB) project, while the additional depth images can further be compressed using one of the newer, more powerful additions of standards like visual or advanced video coding to MPEG family.

The appropriateness of different types of MPEG technologies for effective depth-image compression was tested in a comparison oriented coding experiment. The test group comprised of four codecs, namely, MPEG-2 model codec (TM-5) and Microsoft MPEG-4[10] model codec (MS-Ref.). Illustration is provided in Figure 4.

EXPERIMENTAL RESULTS& CONCLUSION

Some more experimental results are shown in Figure 5. Each of the two images displayed on the left hand side of the graph shows AVC compressed depth information out of any one of the two' orbi ' and ' interview ' test sequences. The bitrate is equivalent to 105 kbit / s and the PSNR is 46.29 dB for the first scene, while the bitrate is equivalent to 115 kbit / s and PSNR is equivalent to 44.16 dB for second video.

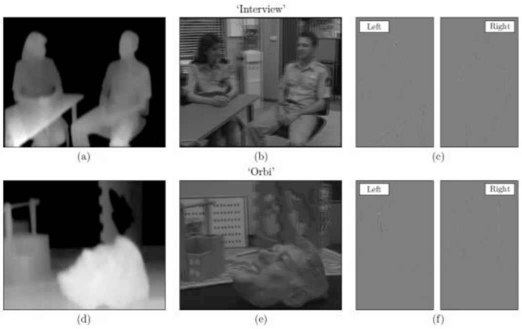

Figure 5: Results (coding and synthesis) of test sequences of "interview" and "orbi"

The photographs support the objective distortion measurements and demonstrate that the visual quality of displayed frames is only marginally degraded compared to the original signals even at those very low data levels. The two images in the center of the graph display overlaid "true" views of the left and right eyes, which were synthesized from the disabled depth images using the shift-sensor algorithm mentioned above.

The device parameters of the "true" stereo camera setup were selected so that the parallax values of frame do not exceed approximately 3 percent of the image width. The two images positioned on the right hand side of graph display the minor synthesis errors or luminance caused by the compression/artefacts of the depth-image.

Human-factors experiments carried out on a single-user, auto-stereoscopic 3D-TV display called lenticular lens raster produced by FhG / HHI within the ATTEST project shows that the effects of impaired synthesis remained visually indistinguishable from those in the corresponding 3D sequences generated with the original and uncompressed depth information.

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