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IMPROVED DEPTH IMAGE BASED RENDERING USING ADAPTIVE COMPENSATION METHOD

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Abstract: Depth image-based rendering (DIBR) is a 2-D–3-D view conversion technology in a space domain that corresponds to depth map. DIBR system requires only a single color image and an associated depth map to generate synthesized auto stereoscopic 3-D views, but the quality of the result is depreciated due to the disoccluded areas in the depth map. Because of this problem, an improved DIBR method that uses a depth map adaptive compensation method is proposed. Using a fast parallax lookup table, the position of holes is allocated and depth map is split into blocks for statistical analysis and classification in order to estimate the quantity of holes. The result of the classification is used for adaptive multimode filtering to optimize the depth map. The experimental results show that the proposed method not only enhances the quality of depth map by compensating for the bigger and smaller areas of holes referring to analysis results, and by determining the filling method using the type of holes, but also reduces the number of holes that retain better depth map and reduces computation time.

Index Terms: Depth image-based rendering, symmetric smoothing filter, asymmetric smoothing filter,depth mapadaptive compensation method, image inpainating.

I. INTRODUCTION

TRADITIONALLY RADITIONAL 2-D images no longer satisfy the increasing pace of improvement to the visual displays in modern technology, and advances in computing hardware and network transmission mean that 3-D viewing has become a new multimedia technology. However, a 3-D view is synthesized using more than two images, which costs more processing resources for compression and transmission. Advanced Three dimensional Television System Technologies (ATTEST) of European information society technology have proposed a conversion method that uses a 2-D image and a corresponding depth map, which is called Depth Image Based Rendering (DIBR), to improve the saving and transmission defects that are inherent with traditional 3-D TV. When video plus depth is used to transmit only the original image and its depth map, the received end reconstructs the multiview image using DIBR. This method increases throughput by 20%, which meets the demands of 3-D view propagation better than traditional methods and finally addresses the problem of insufficient network bandwidth. Depth information is extremely important in DIBR, which has a great impact on the quality of a synthesized 3-D view. Currently, there are three methods to retrieve depth map a depth camera, a stereometric camera, and image structure analysis. A depth camera utilizes light source sensors, such as infrared and laser, to estimate depth map depending on the strength of the reflected light. A stereometric camera uses the calculated parallax between two images taken by two cameras to generate corresponding depth map . Image structure analysis uses characteristics in images to evaluate the depth of objects. Common methods evaluate the sizes, articulation, textural strength and relative position of objects . A multi-virtual view of the left or right image generated by DIBR, requires a depth value to give a dimensional effect according to depth map. Yet holes (or disocclusions) usually occur during 2-D to 3-D view conversion. There are caused by various depth changes and incomplete depth information, which results in a reduced edge for the 3-D images and worse stereoscopic views. The proposed a method to smooth depth maps where significant changes in the information surrounding holes occurs, to improve the 3-D view quality, but the method destroys the vertical line and causes some geometric distor tions in depth maps. An asymmetric smoothing filter to preserve vertical lines, which affects the intensity of non vertical lines and increases the computational complexity. To address this problem, a characteristic analysis that uses a vertical edge-oriented method is proposed ,which applies an asymmetric smoothing filter to areas with strong vertical lines and a symmetric smoothing filter to areas with less robust vertical lines. The proposed method maintains the vertical line of depth map and decreases the effect of holes in DIBR and reduces the computing time. Although this approach maintains the horizontal and the vertical texture information in the depth map, the original information of the depth map is easily lost, because of the various sizes and directions of holes that are created by different sizes and directions of rapid changes in the depth map which results in a deterioration in the 3-D effect. There are several common methods for addressing the hole-filling problem in synthesized 3-D views, such as linear interpolation , linear extrapolation , mirrors, and image inpainting . Although these methods maintain horizontal and vertical lines, they are not suitable for all situations since; the actual retrieved depth map can contain various sizes of holes, because of Kinect sensors . In order to solve this issue, we propose a depth map. Adaptive Compensation method (ADC) to address this problem. Firstly, the positions of the holes in a depth map are located, using a fast parallax look-up table, the image is split into blocks and the size and number of holes within each block is determined and the rendering method is determined according to this analysis result. The depth map is then inpainted in blocks with bigger holes and the texture structure in blocks with smaller holes is analyzed and the asymmetric smoothing filter is applied to areas with robust vertical lines and the symmetric smoothing filter to areas with less vertical lines. Finally, the experimental results show that the proposed method is preserves the original texture of an image with larger holes in the depth map and reduces computing time.

II. LITERATURE SURVEY

Depth Image-Based Rendering (DIBR) techniques have recently received much attention in the broadcast research community as a promising technology for three-dimensional television (3D TV) systems. Whereas, the classical approach requires the transmission of two streams of video images one for each eye, 3D TV systems based on DIBR will require a single stream of monoscopic images and a second stream of associated images, usually termed depth images or depth maps, that convey per-pixel depth information. A depthmap is essentially a two-dimensional (2D) function that gives the depth, with respect to the camera position, of a point in the visual scene as a function of the image coordinates. Since the depth of every point in an original image is known, a virtual image of any nearby viewpoint can be rendered by projecting the pixels of the original image to their proper 3D locations and re-projecting them onto the virtual image plane. Thus, DIBR permits the creation of novel images, using information from the depth maps, as if they were captured with a camera from different viewpoints. A further advantage of the DIBR approach is that depth maps can be coded more efficiently than two streams of natural images, thereby reducing the bandwidth required for transmission. In this vein, it is not only suitable for 3D TV but also for other 3D applications such as multimedia systems. One disadvantage of the DIBR approach is that with this type of data representation, one or more “virtual” images of the 3D scene have to be generated at the receiver side in real time. In addition, it is not an easy task to create new, virtual, images with high image quality. The most significant problem in DIBR is how to deal with newly exposed areas (holes) appearing in the virtual images. Holes are due to the accretion (disocclusion) of portions/regions of objects or background that would have been visible only from the new viewpoint but not from the original location that was used in capturing the original image. There is no information in the original image for these disoccluded regions and, therefore,they would appear empty like holes, in the new virtual image. A simple way to ‘fill’ these holes is to map a pixel in the original image to several pixels in the virtual image by simple inter-polation of pixel information in the foreground or background. More complex extrapolation technique might also be used. However, these filling techniques are known to produce visible disocclusion artifacts in the virtual images, whose severity depends on the scene layout. To deal with these disocclusion artifacts in the virtual images several approaches have been suggested. One approach, termed the layered-depth-image, uses a set of original images of a scene and their associated depth maps. The images and depth maps store not only what is visible in the original image, but also what is behind the visible surface. Note that while this approach is likely to produce very accurate virtual images, it is more computationally demanding and it requires more bandwidth for transmission. An alternative approach involves pre-processing of the depth maps. Recently, we adopted this latter approach and pre-processed depth maps using a symmetric 2D Gaussian filter, so that the disocclusion artifacts were incrementally removed as the smoothing of depth maps became stronger. A further advantage of the DIBR approach is that depth maps can be coded more efficiently than two streams of natural images, thereby reducing the bandwidth required for transmission. Experimental results using formal subjective evaluation techniques indicated that this techniques could be used to significantly improve the image quality of novel stereoscopic views especially when there are blocky artifacts or noise in the depth maps and potential distortions in the newly generated images as a result of disocclusion.

III. PROPOSED SYSTEM

Many previous studies have proposed the concept of a smooth filter to construct different images. However, a fixed sized smooth filter process is less flexible, in terms of adaptation so there are more false holes. To address these issues, an improved DIBR method that uses a depth map ADC is proposed for further refinement. Firstly, the depth value is converted to a parallax value, using the fast parallax look-up table. The depth map is then divided into blocks and the number of holes in each block is determined. There is then classification into three modes: blocks with bigger holes, with smaller holes and with no holes. The texture within the blocks labelled with bigger hole size is detected first. Since the human eye is most sensitive to variation in vertical lines, the proposed method uses a further process to strengthen the vertical line within the blocks. The bigger holes with greater depth values are inpainted, according to the texture directions, and the vertical line analysis is required for rendering the smaller holes, areas with stronger vertical lines are subjected to an asymmetric Gaussian filter, and areas with lesser vertical lines to a symmetric Gaussian filter. No action is taken in areas without holes. Finally, the results for the system after inpainting, are output.

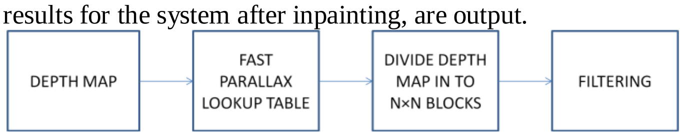

Fig.1.Block diagram of proposed system

1) The Fast Parallax look-up table

To quickly locate the position of holes in the depth map, this work proposes a fast parallax look-up table to convert, Eq compute the corresponding parallax value from the depth value.

$$Parallax = M \times \left\{ 1 - \frac{depth\_value}{255} \right\}$$

where M denotes the greatest parallax, which is generally 5% of the image width depth value denotes the depthvalue in the depth map and Parallax denotes the computed parallax value.

2) Hole Detection

Generally, holes occur where there in an obvious change in depth such as edges and noises. Equation is used to locate hole positions. When the difference in the parallax values of p(x,y) and its neighbor is greater than Th0, p(x, y) is determined as a hole and labeled by Label p(x,y) = 1,

$$Label_p(x,y) = \begin{cases} 1, & \text{if } p(x+1,y) - p(x,y) > Th_0 \\ & \text{for the left view} \\ & \text{if } p(x-1,y) - p(x,y) > Th_0 \\ & \text{for the right view} \\ 0, & \text{otherwise} \end{cases}$$

where the threshold value Th0 is set to20 and p(x, y) denotes the value of depth at (x,y)(p(x, y) denotes the value of parallax for a pixel.

3) Filtering

The depth map is then divided into N×N blocks and the number of holes in each block is determined .Then the block is classified in to three modes: blocks with bigger holes, with smaller holes and with no holes. The texture within the blocks labelled with bigger hole size is detected first. The smaller hole, areas with stronger vertical lines are subjected to an asymmetric Gaussian filter, and hole areas with lesser vertical lines to a symmetric Gaussian filter. No action is taken in areas without holes. Finally, the results for the system after inpainting, are output.

IV. RESULT AND DISCUSSION

Figure shows the four images of Gift, Wood, Books, and Cones, which are selected as test images. Gift and Wood are depth maps with a median level of holes effect, Books contains depth map with a smaller level of holes effect, and Cones has depth map with the greatest level of holes effect. The resolution of all four original images is 696 × 556. Then, the specification of the computer for simulation is Intel Core i7-3770 CPU with 3.4GHz working frequency and 4G RAM. We implemented this by using the Microsoft Visual Studio 2008 in Windows 7 platform.

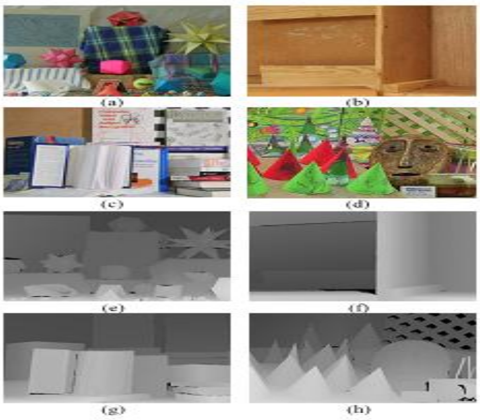

Fig.2. Test images of Gift, Wood, Books, Cones and their corresponding depth map

MatLab is used as the simulation tool for implementing this project as, it is a high performance language for technical computing. It integrates computation, visualization, and programming in an easy to use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include, math and computation, algorithm development, modelling, simulation and prototyping, data analysis, exploration, and visualization, scientific and engineering graphics, and also for application development, including Graphical User Interface building.

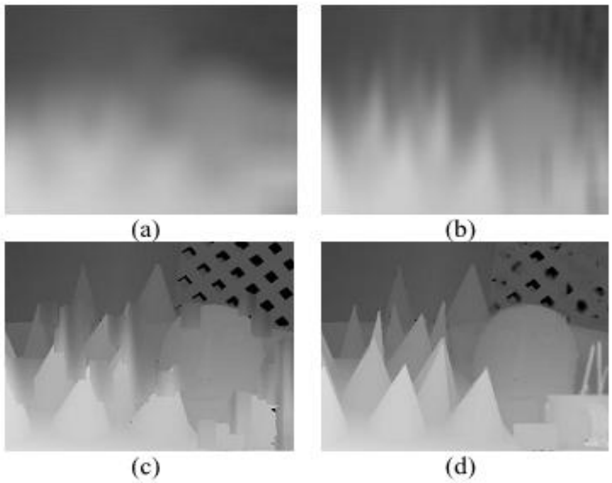

Fig.3. Result of Cones a) symmetric smoothing filter b) asym metric smoothing filter c) adaptive smoothing filter d) This work.

V. CONCLUSION

Low-cost Human-Computer Interaction (HCI) sensors are increasingly important for intelligent/interactive 3-D TV. However, a low-priced device can result in various sizes of holes in depth maps and in the output of in sufficient stereoscopic images from DIBR. In this work, an adaptive block-based strategy is proposed, which adopts content features from separated blocks. The proposed depth map Adaptive Compensation method (ADC) uses a fast parallax look-up table to locate the position of holes and divides the depth maps into sub-blocks, to determine the number of holes and types. The analysis results are used for further classification into three modes and to choose the relevant rendering method that optimizes the depth information. The experimental results show that the proposed method reduces the number of holes after image warping, reduces the computation time, and maintains the original depth map. Most importantly, it provides a better auto stereoscopic 3-D visual quality for DIBR.

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