A MODIFIED 3D BASED STEREOSCOPIC DISPLAY QUALITY ENHANCEMENT BASED ON CROSSTALK REMOVAL

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Abstract—This paper proposed a gain model method to eliminate the crosstalk and motion blur respectively. A crosstalk is always an issue for 3d displays. Crosstalk is a critical factor to determining the image quality of stereoscopic displays. A stereoscopic image quality assessment is an important and challenging issue in 3d application. Quality calculation of crosstalk perception can be carried out on stereoscopic display. Since crosstalk is annoying artifacts in the visualization session of stereoscopic 3d and cannot be completely eliminated with current technology. Stereoscopic three dimensional (3d) techniques is based on simultaneously capturing a pair of two dimensional (2d) images and then separately delivering them to respective eyes. In this paper to proposed in gain model method in digital image processing that could further reduce the optical crosstalk and motion blur in 3d display. Since the proposed process to evaluate image quality and improve accuracy, clarity in static and dynamic image on stereoscopic displays.

Keywords—System Crosstalk, Motion Blur, 3D Images, Stereoscopic Display, Quality Evaluation

1. INTRODUCTION

Stereopsis was first described by Charles Wheatstone in 1838. This visual process leads to the perception of depth from two slightly different perspectives of two eyes. Three dimensional (3D) system is on the verge of constant development in scientific as well as the entertainment community in recent years. With the progress of the times, the need of a better 3D vision has been steadily increasing. The 3D system, including stereoscopic and auto-stereoscopic 3D system, can provide 3D images on flat panel retinas; the differences arise from the 6.5 cm average distance between human eyes.

This paper reviews the literature on crosstalk and related terms in stereoscopic displays and provides a useful basis for the understanding, further analysis and standardization of the terminology relating to 3D crosstalk. Crosstalk is present in most stereoscopic displays and is often the most important factor affecting the 3D image quality. Then, feature similarities between the original and distorted stereoscopic images are measured for the monocular occlusion and binocular rivalry regions as the local monocular and binocular quality maps, respectively. Stereoscopic 3-D digital imaging holds the promise of improving the detection, diagnosis, and treatment of disease as well as enhancing the training and preparation of medical professionals through use of stereoscopic 3-D displays in concert with the many volumetric visualization techniques/modalities developed in recent years. While so-called 3-D graphics have improved the state of computer visualization in general, 3-D displays make full use of the human-visual perception, and thus can provide critical insight in complex computer-generated and video 3-D data.

In recent years, the development of digital radiography, high-resolution digital display systems, and high-quality stereo viewing device has made possible the development of medical stereoscopic imaging techniques that do not suffer from the limitations of the earlier film-based methods[1].

2. PROBLEM STATEMENT

Visual stimuli from both eyes are combined to form a stereoscopic view in the brain. Based on binocular parallax, 3D displays provide two perspectives of the same view to impart precise depth perception[2]. However, imperfect separation between the left-and right-eye images is a serious draw backing 3D display. A viewer's one eye receives not only its own images but also a percentage of images for the other eye. This phenomenon is known as crosstalk and is a major issue that affects the performance of 3D displays.

A. Methodology process:

To using an evaluation index method to quantify 3D image performance for stereoscopic displays. This index assesses the optical quality of a 3D display as well as the effects of image content. The evaluating index (Ax-3d) method should not perfectly eliminate the crosstalk and motion blur in high accuracy ranges. A viewer's one eye receives not only its own images but also a percentage of images for the other eye. This phenomenon is known as crosstalk and is a major issue that affects the performance of 3D displays.

Indicated that a 5% crosstalk level only produced as light reduction in viewing comfort for half of observers. However,
imperfect separation between the left-and right-eye images is a serious drawback in 3D displays. A viewer's one eye receives not only its own images but also a percentage of images for the other eye. This phenomenon is known as crosstalk and is a major issue that affects the performance of 3D displays. Accuracy is low. Required more time to process. The crosstalk and motion blurring is not satisfied.

3. PROBLEM FORMULATION

The problem of in this paper in 3d images should have the motion blur and crosstalk in camera flat panel display. In order to do so we need to mathematically formulate the required objective. In this section I present mathematical equations in related to the 3d stereoscopic display.

4. PROPOSED SYSTEM MODEL

To reduced the motion blur and crosstalk in 3d stereoscopic display for introducing the gain model technique. This gain model process to successfully eliminating crosstalk and motion blur in 3d images.

A. Crosstalk:

Crosstalk is produced by imperfect view separation that causes a small proportion of one eye’s image to be seen by the other eye as well. It is perceived as ghost, shadow, double contours and even a relative small amount of crosstalk can lead to headaches. Therefore, crosstalk is probably one of the main perceptual factors which degrade image quality and visual comfort. However, the descriptive and mathematical definitions of crosstalk and related terms remain ambiguous in the stereoscopic literature as reviewed in Artifacts in the Simplest Stereoscopic System Crosstalk occurs in various stereoscopic displays, while the mechanisms behind can be significantly different ghosting or leakage, high levels of crosstalk can make stereoscopic images hard to fuse and lack fidelity; hence it is important to achieve low levels of crosstalk in the development of high-quality stereoscopic displays. In the wider academic literature, the terms crosstalk, ghosting and leakage are often used interchangeably and unfortunately very few publications actually provide a descriptive or mathematical definition of these terms.

B. Motion blurring

As a result of relative motion between the camera and the object of interest, adjacent points in the image plane are exposed to the same point in the object plane during the exposure time. The intensity of an image of an original point is shared between these image plane points according to the relative duration in which each point is exposed to light from the original point. The smearing tracks of the points determine the PSF in the blurred image. Contrary to other blur causes such as atmospheric or out-of-focus effects, motion blur is usually considered as one dimensional, since during exposure time that is relatively short (in real-time imaging, approximately 1/30 s), motion direction does not change. This in this technique to using the blurred image in the input side to have some matlab coding to produced the original image(de blurred image) that is without crosstalk and motion blur. In the first step the z-coordinate should added in the blurring image. Because of this 3dimensional images to have three coordinate so on. This parameter to successfully eliminating in that blurred image to determining the threshold value in that output image. The following description shows the method to calculate the difference in lightness between the perceived 3d image and the ideal image.

\[ Y(R') = Y(R) + \alpha \times Y(L) - \alpha \times Y(R) \] (1)

\[ Y(L') = Y(L) + \alpha \times Y(R) - \alpha \times Y(L) \] (2)

Where R' and L' are the right eye and left eye images with crosstalk added; R and L are the original right and left eye images, and \( \alpha \) is the crosstalk ratio(%) .

Table 1: five grade score for the perception experiment

<table>
<thead>
<tr>
<th>Grades</th>
<th>Image quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Imperceptible</td>
</tr>
<tr>
<td>2</td>
<td>Perceivable but not annoying</td>
</tr>
<tr>
<td>3</td>
<td>Slightly annoying but acceptable</td>
</tr>
<tr>
<td>4</td>
<td>Annoying</td>
</tr>
<tr>
<td>5</td>
<td>Very annoying</td>
</tr>
</tbody>
</table>

PSNR is defined as:

\[ \text{PSNR} = 10 \log_{10} \frac{L^2}{\text{MSE}} \] (3)

Where L is the dynamic range of the pixel values. For an 8 bits/pixel monotonic signal, L is often set to 255. Average difference: The difference per pixel is averaged and given by root mean squared error (RMSE):

\[ \text{RMSE} = \sqrt{\text{MSE}} \] (4)

Accuracy: It is the ability of a metric to predict subjective ratings with minimum average error and can be determined by means of the Pearson linear correlation coefficient.

Measurement of System-introduced Crosstalk: crosstalk was measured immediately. As introduced in the terminology and mathematical definitions of crosstalk are diverse and sometimes contradictory. We adopt the definition of system-introduced crosstalk a the degree of the unexpected light leakage from the unintended channel to the intended channel [5]. In particular, we measured the leakage in a Situation when the left and right test images have the maximum difference in brightness. The system-introduced crosstalk is measured mathematically as follows.

C. Block diagram:

In this block diagram to removing the crosstalk and motion blur successfully. This blocks are in adding the z-coordinate of the 3d images. The input 3d image should have the crosstalk and motion blur. This image to converting the grey scale value of image then set the threshold grey value.
Finally the gain model process are successfully eliminate these parameters in that 3d images.

The effect of motion blur on real images was analyzed in detail in Ref. 13. Since the motion blur is usually one dimensional, its effect varies according to the direction in the blurred image relative to the motion direction. Since the PSF is varying in the motion direction, it is not correlated perpendicularly to the motion direction. On the other hand, implementation of a whitening filter in the motion direction will have a different effect. The PSF has the same effect on all the image points. The points of the original image will become PSF patterns that merge into each other, forming the blurred image. A whitening derivative filter in this direction will form patterns similar to that of the PSF derivative. The intensity of an image of an original point is shared between these image plane points according to the relative duration in which each point is exposed to light from the original point. The smearing tracks of the points determine the PSF in the blurred image.

\[
I_l = L_x G_l(WB) - L_x G_l(BB)/ L_x D(WB) - L_x D(BB)
\]

where WB denotes a pair of test images (the left image is in white completely whilst the right in black), and BB is another image pair both in black[8].

In this paper we propose a new method to estimate the blur function given only the motion-blurred image. In this paper investigated the motion-blurring effects on an image and established the basic concepts with which blur characteristics such as direction and extent were extracted from the blurred identification of the motion blur function:

The blur function needed for direct restoration of the blurred image can be completely described by the PSF or by the optical transfer function (OTF), which is the Fourier transform of the PSF. The OTF can be formulated as

\[
\text{OTF} = \text{MTF} \exp(j \cdot \text{PTF})
\]

Where the modulation transfer function (MTF) is the absolute value of the OTF and the phase transfer function (PTF) is its angle. The effect of motion blur on real images was analyzed in detail in Ref. 13. Since the motion blur is usually one dimensional, its effect varies according to the direction in the blurred image relative to the motion direction. Since the PSF is varying in the motion direction, it is not correlated perpendicularly to the motion direction.

The first necessary step of the method should be identification of the motion direction relative to the image axis. Since the motion blur is usually one dimensional, its effect varies according to the direction in the blurred image relative to the motion direction. Since the PSF is varying in the motion direction, it is not correlated perpendicularly to the motion direction [13].

Crosstalk Level:

In order to simulate different levels of system-introduced crosstalk for different displays, crosstalk were added to three 3D image pairs, to each of which four different crosstalk levels were introduced using the algorithm developed in . This algorithm can be summarized by the following equations,

\[
\begin{align*}
\text{RCP} &= \text{Ro} + p \times \text{Lo} \\
\text{LCP} &= \text{Lo} + p \times \text{Ro}
\end{align*}
\]

where Lo and Ro denote the original left and right views, LCP and RCP are the distorted views by simulating system-introduced crosstalk distortions, and the parameter p is to adjust the level of crosstalk distortion.

Understanding of Crosstalk Perception:

After identifying the significant factors, their relationship with the perceptual attributes of crosstalk can be modelled. Because the perceptual attributes of crosstalk are the sensorial results of HVS and closer to perceptive viewpoint, the gap between low-level significant factors and high-level users’ perception on crosstalk can be bridged. Ten test stimuli with different amplitudes of the significant factors were selected to represent the perceptual attributes of crosstalk[6].
Assessment of stereoscopic crosstalk perception:

Fig 5: Left eye view for scene contents champagne and dog with different combination of camera baseline and crosstalk level.

Separation Distance of Crosstalk:

We define it as the distance of crosstalk separated from the original view. Crosstalk is more annoying with increasing the separation distance. When viewing the Champagne and Dog presentations from top down wards in these condensed fourth columns, it can be noticed that the separation distance of crosstalk becomes larger with the increase of camera baseline[9].

Fig 6: Visual integration for moving images displayed on hold type display.

It indicates that camera baseline reflects the separation distance of crosstalk, which shows how camera baseline has a relationship with separation distance. Moreover, the separation distance of crosstalk is more visible in Champagne presentations as opposed to Dog. This confirms that the 2-factors interaction between camera baseline and depth of scene content relates to separation distance of crosstalk. Thus, the integration is performed in the following equation,

\[ \text{Cp dep} = L_s \times (1 - \text{Rp dep}/255) \]  \hspace{1cm} (9)
\[ \text{Vp dep} = \text{AVG} (\text{Cp dep}) \]  \hspace{1cm} (10)

Where \( \text{Cp dep} \) and \( \text{Vp dep} \) denote the combined map and the quality value predicted by the objective metric, respectively. \( \text{AVG} \) denotes the average operation.

Crosstalk = \[ \frac{I_1}{I_1 + I_2} \] \times 100\% \hspace{1cm} (11)

Where \( I_1 \) is the maximum intensity value for a single viewing zone at a specific position, and \( I_2 \) is the intensity value of the nearest neighboring zone at the same position. Given the similarity concluded in Subsection 2D, the shape of this spectral density should be similar to that of the PSF derivative power spectrum. The similarities between the true and the identified MTF’s and PTF’s are presented respectively.

Advantages:

Successful elimination of crosstalk and motion blur. Accuracy is increased than the existing method. Required less time to process. Cost is less. Suitable for all 3d stereoscopic display process.

5. EXPERIMENTAL RESULT:

Fig 8: Input Image

In this input image blurring and cross talk are present. The diameter of this input image is 560 × 720. This 3d input image contains motion blur and crosstalk. And crosstalk cannot fully represent the human perception on the 3D image. Therefore, we believe could be a suitable candidate to evaluate 3D images. In addition, according to the human perception experiment performed, crosstalk is only one of the factors that can affect 3D image quality. In this input image the presenting of crosstalk and motion blur are eliminate in the 85% of ranges. In this method it very useful for the medical and military application also.

Fig 9: Output Image
The above image is the output image. This output image is successfully removing the parameter of crosstalk and motion blur also. This parameter are should always affecting the 3d images, so this parameter are eliminate to using in this method.

6. CONCLUSION

This paper contributes to the field of quality evaluation on stereoscopic 3d media in motion blur and crosstalk aspects. First crosstalk perception was mainly carried out on this paper. However crosstalk is not only the relevant factor to image performance. According to the experimental results of this study motion blur can also affects 3d image performance. Thus a new gain model technique was proposed in this paper. This method to combines these two factors to evaluating the quality performance of 3d display. This paper has reviewed the descriptive and mathematical definition of crosstalk and relative term (system crosstalk, 3d image, motion blur) in stereoscopic literature. Finally to determine the threshold value for this static and dynamic performance of 3d display. This proposed gain model method has been proven to successfully eliminate the crosstalk and motion blur in the 3d stereoscopic displays.

REFERENCES