An Ultra Low Cost 2D-to-3D Video Conversion System

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Abstract

We propose an ultra low cost 2D-to-3D conversion system which generates depth maps using global scene depth gradient and texture-based local depth refinement. The depth gradient strength of global scene is generated by only analyzing the edge feature horizontally. Then the local pixel value, Y, Cb, and Cr component of the video content is used to refine the detail depth value. Combining the global depth gradient and local depth refinement, the depth map has a comfortable and vivid quality with very low computational complexity. The system uses only line-based algorithm and can be easily integrated into the display chip.

[1]**Keywords**: 2D-to-3D Conversion, Depth map generation

(A) **Oral/Poster Preference:** Both

(B) **Symposium Topics**: Applications, Display Electronics:

(C) Main author/presenter Chao-Chung Cheng is currently a student.

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[1] Chao-Chung Cheng, A Low-Cost 2D-to-3D Video Conversion System

(1) Objective and Background:

3D displays generate spectacular visual experience than conventional 2D displays and benefit many applications, such as broadcasting, movie, gaming, photographing, etc. However, the lack of an effective 3D content generation approach is a dilemma for 3D industry. For the existing 2D content, a 2D-to-3D conversion system is an important technique for the 3D display.

(2) Method:

In this paper, we propose a low cost 2D-to-3D conversion system. The goal of this project is to generate fast and effective depth map for 2D video using limited resource. The proposed algorithm uses only edge map, Y, Cb, and Cr component with simple operations. Then, the depth map is used to render the two/multiple view angles for various types of 3D display and 2D enhancement in conventional 2D display [1]. The block diagram is shown in Fig. 1. The depth generation core includes two major parts. One is the edge-feature based global depth gradient assignment to generate an initial scene depth map. The other is the local depth refinement using the texture value.

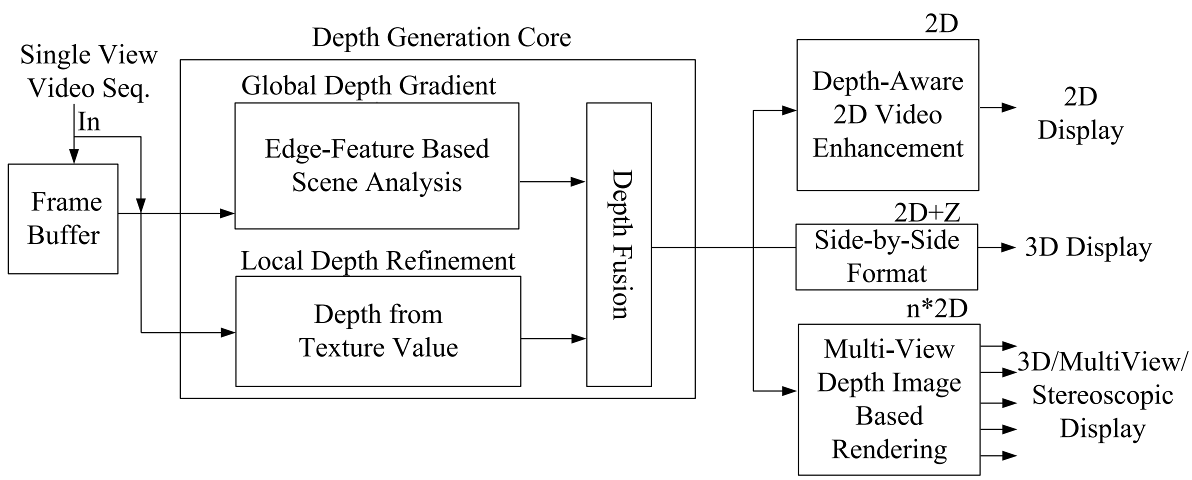


Fig. 1. The block diagram of the proposed 2D-to-3D video conversion system.

Fig. 2 shows the data flow of proposed algorithm. In the global depth map generation, we accumulate the edge of the frame horizontally to get the information about the horizontal complexity of the frame. The cumulative edge count is then calculated from top to bottom and is normalized from 0 to 255. The edge calculation processing gives an initial gradient strength on the global depth map. When the edge complexity of the horizontal line is higher, the more depth gradient will be assigned. From our experiment, the method gives a sharper depth change between object and smooth sky, and the upper-boundary of defocus background and in-focus object. The depth assigning method has better protrusion effect than using an all linear depth gradient.

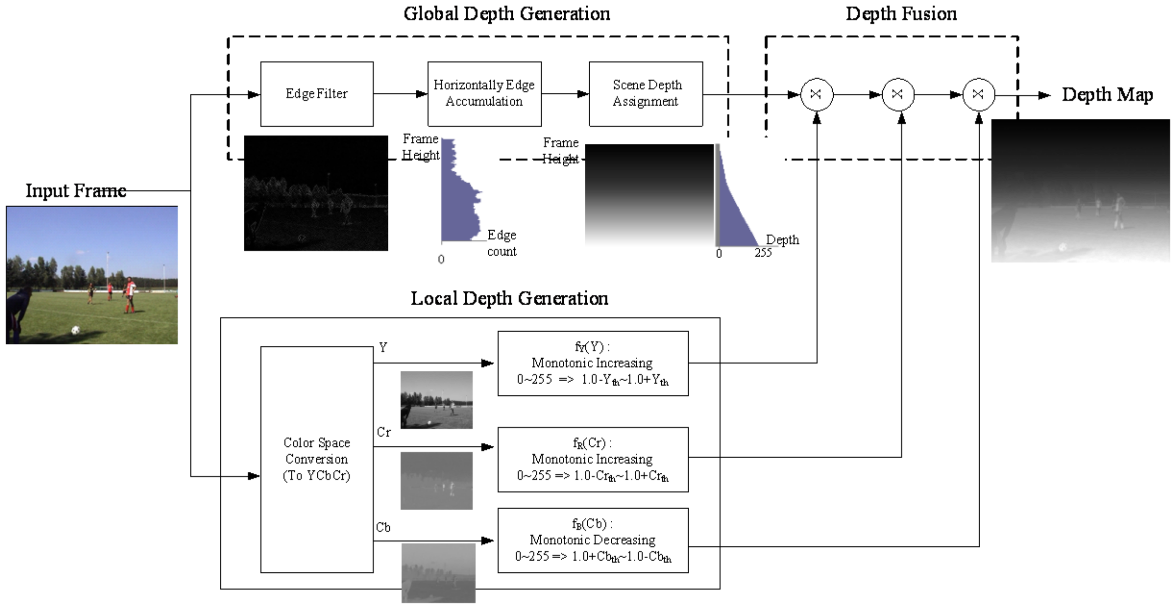


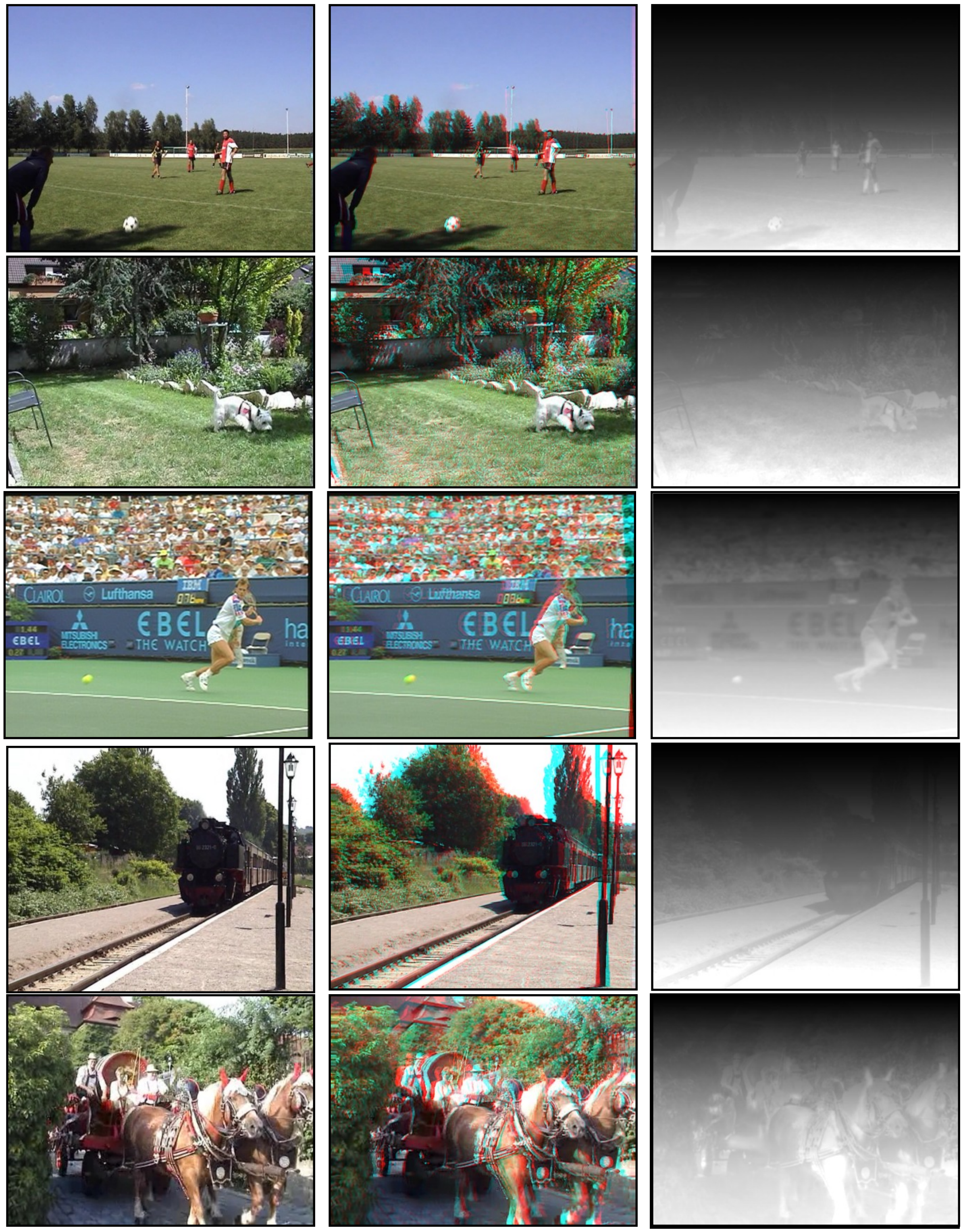
Fig. 2. Data flow of the proposed 2D-to-3D conversion algorithm

In the local depth assignment, we use a novel combination of Y, Cb, and Cr channel. In some case, closer to the red (warm) color, and feel further to blue (cold) color. Moreover, people feel object with higher luminance closer than lower one. The texture value can used as a refinement index of the depth [6]. Therefore, we use the Y, Cb, and Cr to refine the local depth map. As shown in Fig.2, Y is mapping to a linear increasing gain from $1\text{-}Y_{th}$ to $1\text{+}Y_{th}$, so as the Cr value. Cb is mapping to a linear decreasing gain from $1\text{+}Cb_{th}$ to $1\text{-}Cb_{th}$. The value Y_{th}, and Cb_{th} is about 0.3 to 0.1, and Cr_{th} is about 0.3 to 0.5 in our implementations. In the depth fusion stage, the equation $G*f_Y(Y)*f_R(Cr)*f_B(Cb)$ is applied to generate the final depth map.

In the perspective of implementation, the global depth map generation in a line-based operation. And can easily reuses the edge map of video processing core. The Y, Cr, and Cb data are already in the display system. It means the implementation can be easily achieved and combine the line operation without additional line buffer. Corresponding hardware also are implementing in our project.

(3) Results:

In Fig. 3, we show multi-view and red-cyan images by multi-view DIBR. Through this technique, the depth information can be used to generate arbitrary views from original sequences. The holes of rendered images are carefully filled by using edge-dependent algorithm in previous work [5]. The simulation result shows that the local depth refinement generates comfortable result and effectively enhances the monotonic global depth gradient.



Original 2D | Converted 3D | Depth Map

Fig.3. Red-Cyan images of some test sequences.

(4) Impact:

The major contribution of the proposed method is that we proposed an ultra low cost algorithm to convert 2D video to 3D video. The method is suitable both for hardware implementation and software applications. The depth form motion [1][2] and segmentation-based algorithm[2] have very high complexity. These limit the application on some limited-resource products. Although the moving objects have less protrusion effect than the motion-based algorithm but the proposed method has the advantage of lower side effect.

(5) References:

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(6) **Prior Publications:** *No*