3D Saliency Detection

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Abstract *— Saliency is the most important part of an image. An image will have more than one salient areas. Human eye can identify the salient regions of natural scene. There are many methods for saliency detection in 2D images. Here, a model for saliency detection in 3D images is proposed. A 3D image and its depth map are given as inputs. From these two inputs a 3D image is created and its saliency map is generated as the final output. 3d saliency detection models are useful for various multimedia applications. This model can effectively identify the salient regions in 3D images and enhances those regions in the final 3D saliency map.*

Keywords — *3D image; saliency; saliency map*

I. INTRODUCTION

In today's digital world, large amount of multimedia content are observed by human beings. From these, human visual system can extract most significant part and they give attention to only those parts. These parts are called salient regions. Nowadays, 3D multimedia applications are emerging day by day. As the 3D data increases, 3D saliency detection models are necessary for extracting the essence of 3D multimedia or 3D image. A 3D image gives 3 dimensional view of that image. 3D images will have a depth factor. When developing a model for 3D saliency detection, depth factor has a vital role. Humans use some tools for depth perception such as stereoscopic vision, accommodation, parallax, size familiarity and aerial perspective. In the proposed model, 3D image is generated by combining a 2d image with its depth map. Another way to generate a 3d image is by using a stereoscopic camera. It will give left and right view of an image. By viewing this left and right view through a 3D glass, a 3D image can be obtained. Creating a 3D image is a three phase process with phases tessellation, geometry and rendering.

II. RELATED WORK

There are many saliency detection models for 2D images and objects. Neil Bruce and John Tsotsos proposed a model based on the principle of maximizing information sampled from a scene[1]. Radhakrishna et al. presented a model to detect salient regions in an image using low level features of luminance and color[2]. Ming-Ming Cheng et al. proposed a salient region detection based on the simultaneous evaluation of global contrast differences and spatial weighted coherence scores[3]. Hengue Pan and Hui Jiang proposed a fast deep learning method that detects object saliency using convolutional network[4].

III. PROPOSED MODEL

In this proposed model, 2D image and its depth map are given as inputs. A depth map contains the depth information of each pixel. From the 2D image, 2D saliency map is computed. Using the depth information from the depth map, depth saliency map is computed. These two maps are combined using a fusion method to generate the final saliency map. Additional attention is given to middle regions because of the assumption that usually salient regions in an image will be in the middle region. The outline of the proposed model is given below. Here, the model is based on the concept of context-aware saliency, ie, detecting not only the salient regions but also the background region that contributes to the context of the image. And it follows some basic principles of human visual system:

- Low-level features
- High-level features
- Abolishing frequently occurring features.
- Visual organization rules

To enhance saliency map, additional attention is given to middle regions to enhance the saliency.

A. 2D Saliency Detection

2D image given as input is divided into patches. To detect the 2D saliency and to compute the 2D saliency map, normalized Euclidean distance is used as a measure. For a pixel to be salient it should be distinct from all other pixels. For that Euclidean distance between patches is calculated. Dissimilarity between patches is inversely proportional to patch distance. Salient pixels will be always together. Background pixels will have similar pixels both near and far away. So, if a pixel is salient then the similar pixels are near to the pixel otherwise non-salient. For this, multi-scale saliency enhancement is used. A pixel is represented in multiple scales and it is said to be salient if it is consistently distinct from all other pixels in multiple scales.

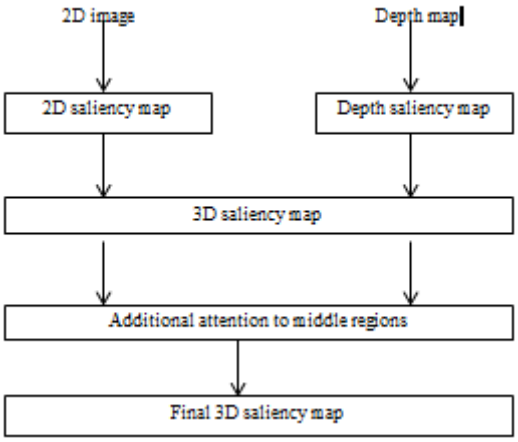

Fig 1: Proposed model

B. Depth saliency map calculation

A depth map contains depth information about each pixel of an image. It is an image channel that contains the information about distance of the surfaces of the image from a view point. Depth saliency is computed using the method as in the 2D saliency computation.

C. 3D saliency map Fusion

After computing the 2D saliency map and depth saliency map, next step is to fuse them to obtain the final 3D saliency map.

$$S(i,j) = \lambda 1 S_{dep}(i,j) + \lambda\, 2 S_{2d}(i,j) \quad (1)$$

Where, $\lambda 1 = \lambda 2 = 0.5$, $S(i,j)$ is the 3D saliency, $S_{dep}(i,j)$ is the depth saliency and $S_{2d}(i,j)$ is the 2D saliency. Saliency map obtained can be enhanced to get the final 3D saliency map by giving additional attention to the middle regions.

IV. EXPERIMENTAL RESULT

The result of the proposed model is given below. 2D image and its depth map is given as the inputs. 2D saliency map, depth saliency map and 3D saliency map are obtained as outputs.

Fig 2: 2D image

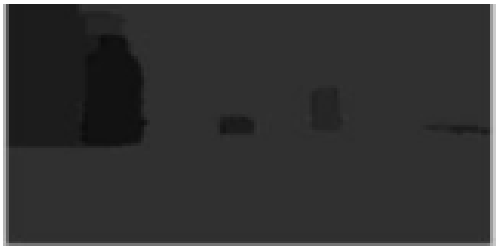

Fig 3: Depth map

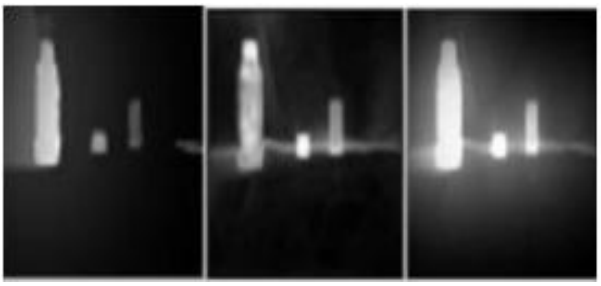

Fig 4: (a)depth saliency map(b)2D saliency map(c)3D saliency map

V. APPLICATIONS

A. Image retargeting

Image targeting is resizing of an image by shrinking or expanding the non-informational region. So, retargeting algorithm make use of the saliency map to identify the salient regions.

B. Collage Creation

In collage creation, the pieces should be neat and matched. Today collage can be used as a summarization method. In summaries, the salient objects must be maintained.

C. Surveillance

Smart eyes attending and recognizing salient events.

VI. CONCLUSION

Proposed method effectively detects the salient regions of 3D images in a 3D saliency map by combining 2D saliency map and depth saliency map. 2D image and its depth map are given as the inputs. From these inputs, 2D saliency map and depth saliency map are computed. Then both of them are fused to obtain the final 3D saliency map.

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