Automatic Region Selection For Objective Sharpness Assessment of Mobile Device Photos

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Introduction

Mobile device photos now have fairly good visual quality without noticeable distortion.

It is inappropriate to take the whole photo into account.

So an automatic local region selection algorithm is necessary before evaluating mobile device photo sharpness.

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The Overall Framework

- Image pre-processing
- Extraction of feature map
- Calculation of regional scores

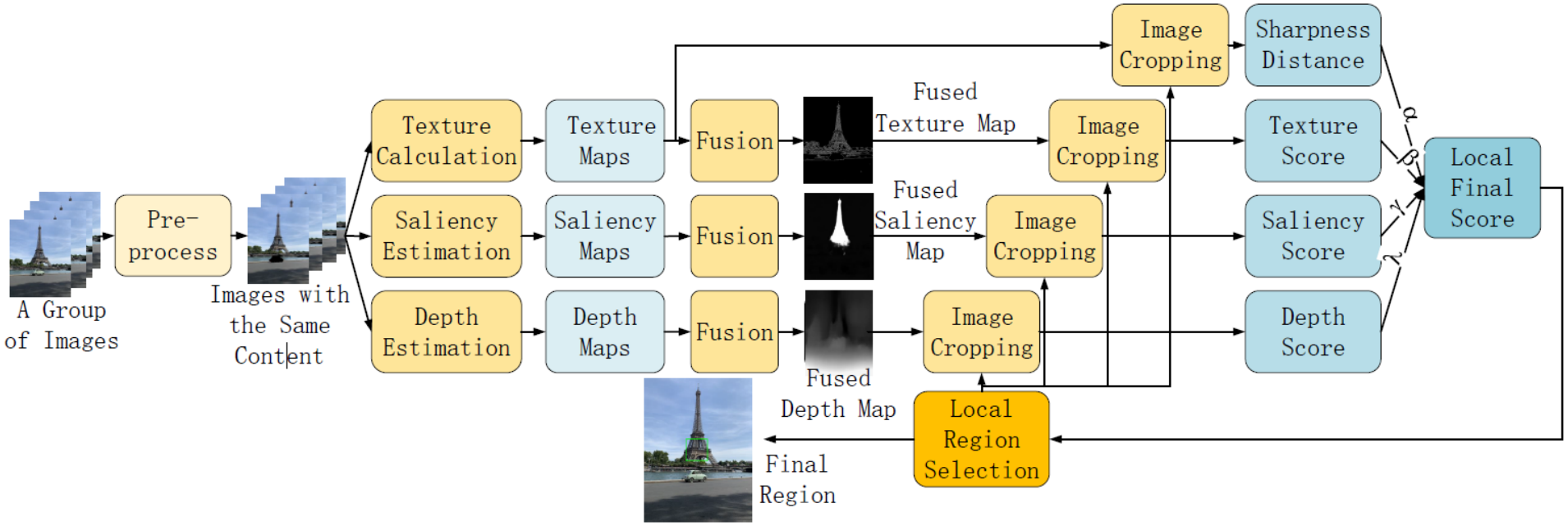
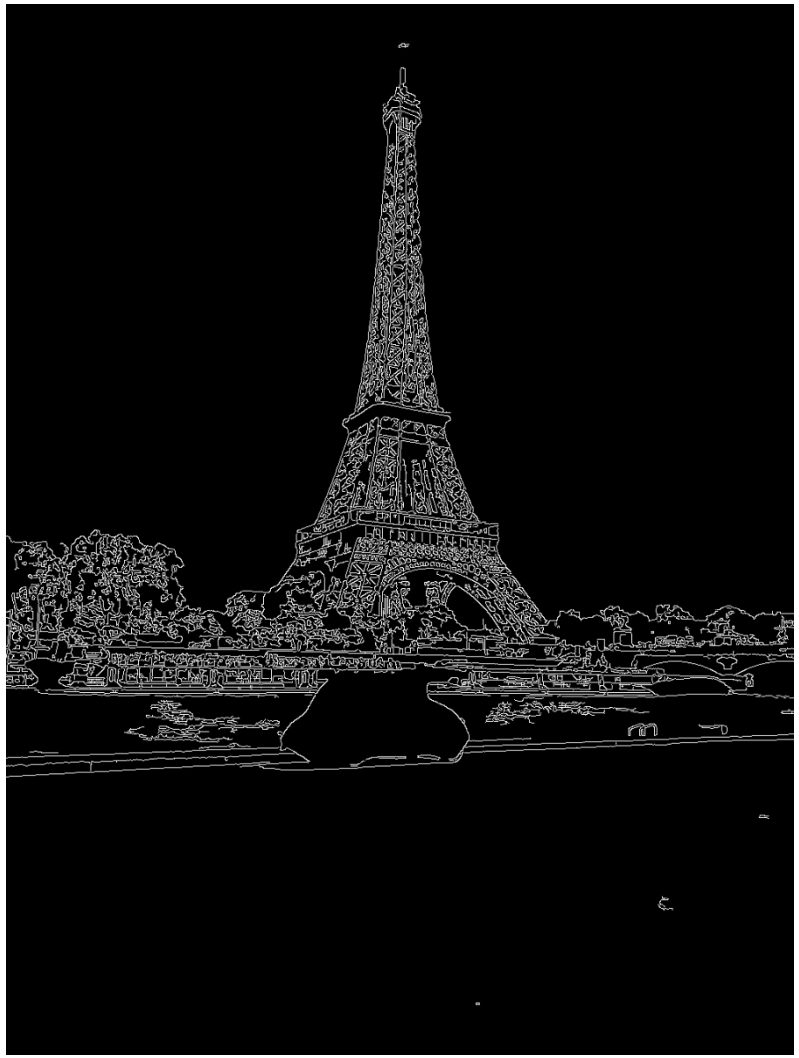


Image pre-processing

- Remove moving objects
- Transform the images to the same scale according to the mapping matrix between feature points.
- The image boundaries are discarded.

Texture map

- Filter the image with a bilateral filter.
- calculate the horizontal and vertical gradients of the image respectively.
- Non-maximum suppression is performed to preserve most edges of the image.



Saliency map

- We implement a salient object detection method according to [1].
- This network is based on the publicly available TensorFlow framework and FCN.
- VGGNet is chosen as the pre-trained model for better effects.

[1] Qibin Hou, Ming-Ming Cheng, Xiaowei Hu, Ali Borji, Zhuowen Tu, and Philip HS Torr, “Deeply supervised salient object detection with short connections,” in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2017.

Depth map

- According to [1], we realize a monocular depth estimation method.
- A minimum reprojection loss, a full-resolution multi-scale sampling method, and an auto-masking loss bring us satisfactory results.

[1] Cl´ement Godard, Oisin Mac Aodha, Michael Firman, and Gabriel J Brostow, “Digging into self-supervised monocular depth estimation,” in Proceedings of the IEEE International Conference on Computer Vision, 2019, pp. 3828–3838.

Sharpness distance & Region score

$R_r^i(x, y)$ is region r of image i, and the number of pictures is N.

$$dis_r(i,j) = |\sum_x \sum_y R_r^i(x,y) - \sum_x \sum_y R_r^j(x,y)|. \quad (1)$$

$$D_r = \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} dis_r(i,j). \quad (2)$$

$$\begin{aligned} Score_r &= \alpha \sum_x \sum_y Tex_r(x,y) + \beta \sum_x \sum_y Sal_r(x,y) \\ &+ \gamma \sum_x \sum_y Dep_r(x,y) + \lambda D_r. \end{aligned} \quad (3)$$

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Photo Sharpness Measure Database

- 100 different types of scenes.
- Apple iPhone X, Samsung Galaxy S9+, Huawei Mate20 Pro and Mi 9
- At least three experts in the field of image quality rate the sharpness.
- The mean opinion score (MOS) is calculated and represents the final score of each photo.

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Experimental Results

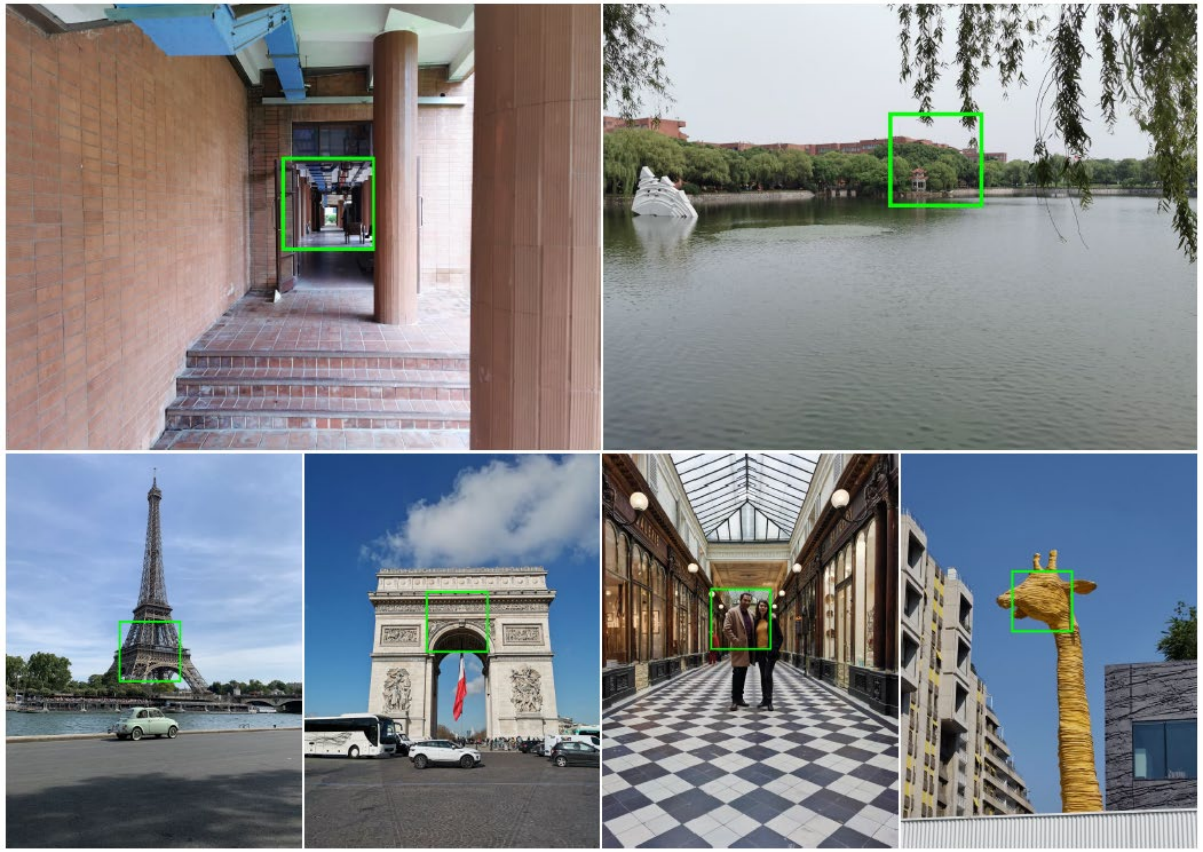

Table 1. PLCCs and SROCCs of ARISMC, FISH, JNBM and CPBD on the local region our algorithm selects and some other regions.

Algorithms	Input Regions	PLCC	SROCC
ARISMC	Global Image	0.5845	0.5691
	Random Region	0.5999	0.6004
	Center Region	0.6371	0.6329
	Our Region	**0.6424**	**0.6357**
FISH	Global Image	0.5929	0.5476
	Random Region	0.5742	0.5487
	Center Region	0.6675	0.6153
	Our Region	**0.6683**	**0.6479**
JNBM	Global Image	0.3209	0.3147
	Random Region	0.5198	0.4977
	Center Region	0.6038	0.5808
	Our Region	**0.6244**	**0.6129**
CPBD	Global Image	0.4563	0.4224
	Random Region	0.5004	0.477
	Center Region	0.5734	0.5586
	Our Region	**0.6189**	**0.6136**

Thank you!

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