Practical Wide-Angle Portraits Correction with Deep Structured Models

Jing Tan*, Shan Zhao*, Pengfei Xiong*, Jiangyu Liu, Haoqiang Fan, Shuaicheng Liu

https://github.com/TanJing94/Deep_Portraits_Correction

Motivation

(a) Input Image (b) Output Image

Correct Portraits in Wide-Angle Photos

- Input: A distortion image with curved background and distorted faces
- Output: The undistorted image without artifacts on buildings or faces

Contributions

Network

- Propose the first deep learning based method
- Achieve competitive undistorted result
- Automatically process with good universality

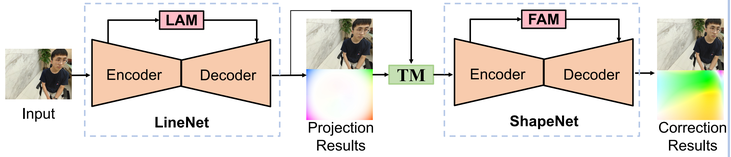
Metrics

- Designed for the quantitative evaluation

Dataset

- Used for image undistortion
- Various subject identities, scenes and camera modules

Method

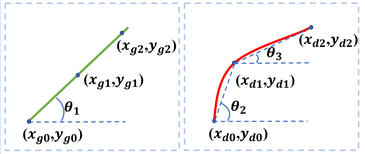


Network Architecture Overview

- LineNet: undistort the perspective effects for line correction
- LAM: facilitate the localization of lines
- ShapeNet: adapt to the stereographic projection on facial regions
- FAM: facilitate the localization of faces
- TM: ensure smooth transitions between LineNet and ShapeNet

Metrics

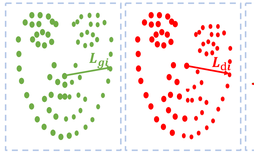
Line Straightness Metric

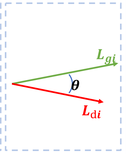


$$S_g = \frac{y_{g_0} - y_{g_n}}{x_{g_0} - x_{g_n}}$$

$$\mathrm{LS} = 1 - \left(\frac{1}{n}\sum_{i=0,\dots,n-1}\left[\frac{y_{d_i} - y_{d_{i-1}}}{x_{d_i} - x_{d_{i-1}}}\right] - s_g\right)$$

Shape Congruence Metric





$$\mathrm{FC} = \frac{1}{n}\sum_{i=0,\dots,n-1}\left[\cos(L_{g_i}, L_{d_i})\right]$$

$$\cos(L_{g_i}, L_{d_i}) = \|L_{g_i}\|\|L_{d_i}\|cos\theta)$$

Dataset

A novel wide-angle portrait dataset is created, containing distorted and undistorted image pairs with various scenes, identities and camera modules.

Creation Steps

(1) Correct perspective distortions

(2) Run Shih's[1] algorithm

(3) Improve by adding line constraints and adjusting hyper-parameters

(4) Further correct by manual tool

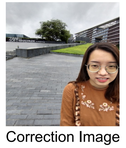
Single Training Sample

Input

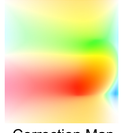
Projection Image

Projection Map

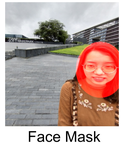
Lines



Correction Image



Correction Map



Face Mask

Ablation Study

No.	LAM	ShapeNet	TM	FAM	Lmk Loss	Proj LineAcc	Corr LineAcc	ShapeAcc
1) LineNet						66.745	\	97.380
2)	✓					66.856	\	97.391
3)		✓				66.707	66.439	97.458
4)	✓	✓				66.873	66.472	97.472
5)	✓	✓		✓		66.938	66.484	97.479
6)	✓	✓			✓	66.985	66.541	97.473
7)	✓	✓	✓	✓		**67.069**	**66.575**	**97.485**
8)	✓	✓	✓	✓	✓	**67.135**	**66.784**	**97.490**
9) Input						66.064	66.064	97.455
10) Proj Img						\	\	96.876
11) Shih[1]						66.143	66.143	97.253

Step-wise decompose our approach to reveal the effect of LAM, ShapeNet, TM, FAM module and Imk Loss, respectively. The LineAcc and ShapeAcc are adopted for the evaluation, where LineAcc is evaluated on results of both LineNet and ShapeNet, expressed as Proj LineAcc and Corr LineAcc respectively.

Visualization of the difference performance of the network with or without LAM, FAM and TM module, respectively.

Comparison with Other Methods

No.	Note testset		Vivo testset		All testset		google	
	Line Acc	Shape Acc	Line Acc	Shape Acc	Line Acc	Shape Acc	Line Acc	Shape Acc
Ours wot note	67.605	97.061	**64.997**	98.341	**66.464**	97.464	\	\
Ours wot vivo	**68.299**	97.109	63.418	**98.361**	66.324	**97.483**	\	\
Ours with all	**68.683**	**97.115**	**65.148**	**98.363**	**66.784**	**97.490**	**64.650**	**97.499**
Google(Shih[1])	66.886	**97.267**	63.087	98.238	66.143	97.253	**61.551**	**97.464**

Quantitative comparisons of ours and Shih[1] on different test sets.

(a) Input (b) Projection (c) iPhone12's (d) Xiaomi10's (e) Ours

Qualitative comparison between our method and some phones with wide-angle portrait correction.

(a) Projection Image (b) Stereo Image (c) Shih's Result (d) Our Result

Qualitative comparison results. Notice the coordination of face area and line curvatures in the transition area.

References:

[1] YiChang Shih, Wei-Sheng Lai, and Chia-Kai Liang. Distortion-free wide-angle portraits on camera phones. ACM Trans. Graphics, 38(4):1–12, 2019.