Inner Eye Canthus Localization for Human Body Temperature Screening

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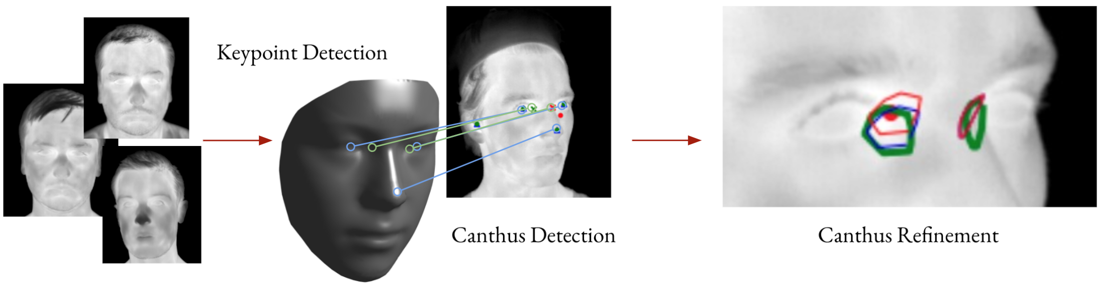
Introduction

- Infrared thermography is the most efficient non-contact, reasonably accurate solution for fever screening;
- International ISO standards[1] require measuring temperature at the inner eye canthus region;
- Our method exploits OpenPose [2] and a 3D Morhpable Face Model (3DMM) [3], to detect the inner eye canthus, estimate the head rotation, and detect self-occlusions.

Pipeline

Step 1: detect 5 keypoints using [2]; **Step 2**: use a 3DMM to estimate the head pose, project the 3D model in 2D and locate the inner canthus; **Step 3**: refine the canthus localization by searching for the warmest point.

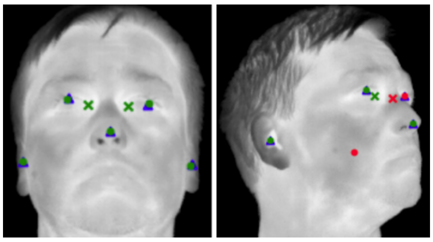


Canthus Detection

Given 2D and 3D keypoints $\mathbf{l}_{op}$, and $\mathbf{L}_{op}$ estimate the camera matrix as:

$$\mathbf{l}_{op} = \mathbf{A} \cdot \mathbf{L}_{op} + \mathbf{t}$$

Use $\mathbf{A}$ to project the 3D model to the image and locate the inner canthus (**green crosses**). From $\mathbf{A}$, recover the 3D rotation $\mathbf{R}$ and a visibility mask to detect self-occlusions (**red points**).



Canthus Refinement

- Define the convex hull $\mathcal{K}$ of the k-ring of canthus center;
- Find the hottest point in $\mathcal{K}$;
- Estimate new canthus center;

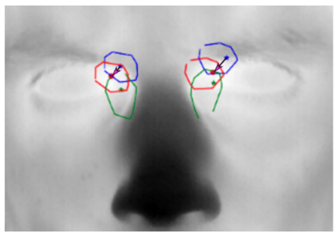


Figure 1: Blue:Estimated chantus, Green:GT chantus, Red: Refinement.

Results

Tests conducted on the Thermal FaceDB dataset, 2935 thermal frames of 90 subjects annotated with 68 facial landmarks;

		FAN [42]	OP+3DMM	Refinement
1-Ring	IoU	-	16.5 ± 3.5	8.1 ± 2.1
	NME (man)(%)	6.8 * ± 2.1	4.1 ± 0.3 *	5.6 ± 1.3
	NME (gt)(%)	6.5 * ± 2.2	3.7 ± 0.3 *	4.9 ± 1.3
2-Ring	IoU	-	32.5 ± 4.8	23.4 ± 3.6
	NME (man)(%)	6.8 *± 2.1	4.1 ± 0.3 *	5.1 ± 1.1
	NME (gt)(%)	6.5 *± 2.2	3.7 ± 0.3 *	4.5 ± 1.1
3-Ring	IoU	-	41.7 ± 4.5	34.6 ± 2.8
	NME (man)(%)	6.8 *± 2.1	4.1 ± 0.3 *	4.8 ± 1.2
	NME (gt)(%)	6.5 *± 2.2	3.7 ± 0.3 *	4.3 ± 1.1
4-Ring	IoU	-	47.1 ± 4.5	39.8 ± 2.8
	NME (man)(%)	6.8 *± 2.1	4.1 ± 0.3 *	4.8 ± 1.1
	NME (gt)(%)	6.5 *± 2.2	3.7 ± 0.3 *	4.4 ± 1.1
	Occlusion (%)	-	89.9	-

https://www.micc.unifi.it/resources/datasets/thermal-face/

References

[1] *www.iso.org/standard/69347.html.*

[2] Cao Zhe et al. Openpose: realtime multi-person 2d pose estimation using part affinity fields. *IEEE TPAMI.*

[3] Ferrari Claudio et al. A dictionary learning-based 3d morphable shape model. *IEEE TMM.*

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