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UNIVERSITY OF JYVÄSKYLÄ

Evaluation of Face Image Quality Metrics in Person Identification Problem

Vladimir Khryashchev

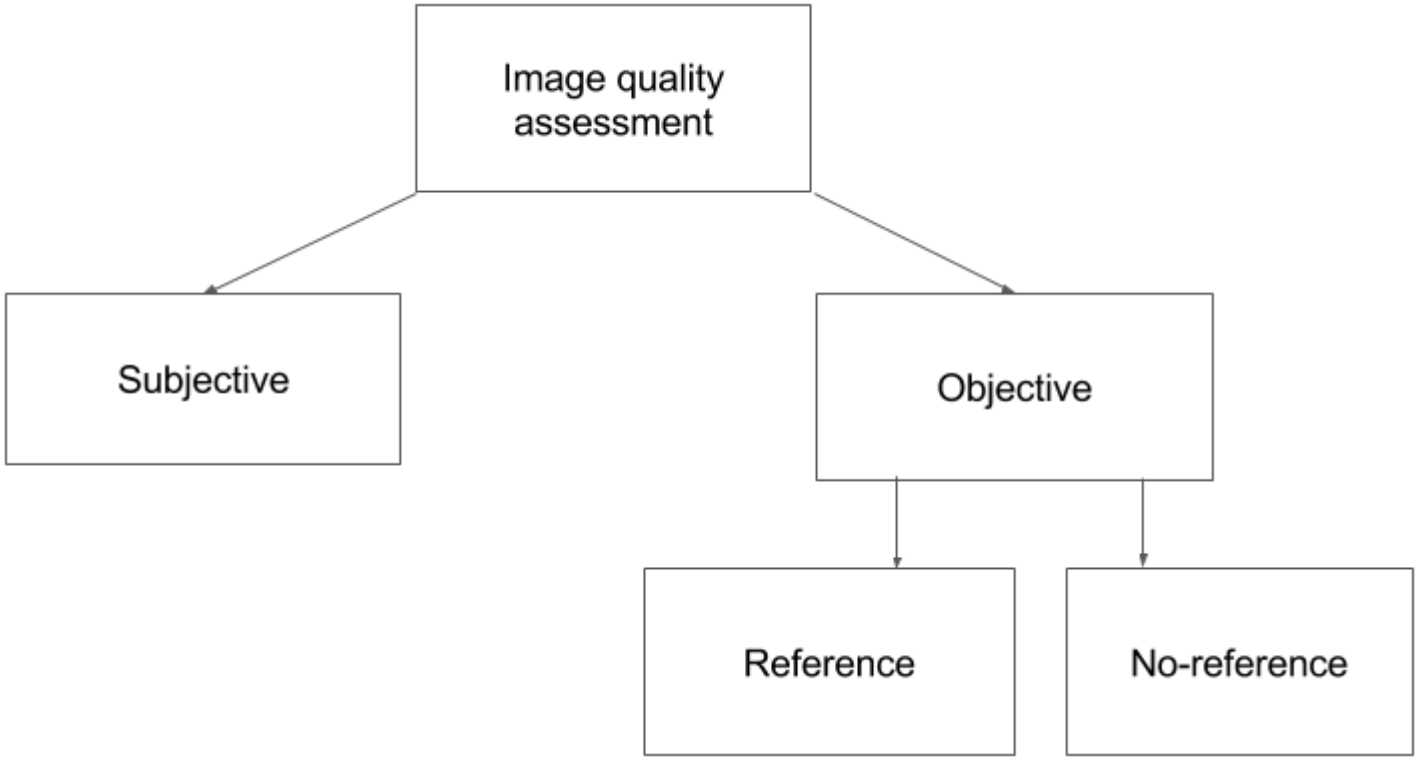
P.G. Demidov Yaroslavl State University, Russia

Quality assessment problem

Reference image

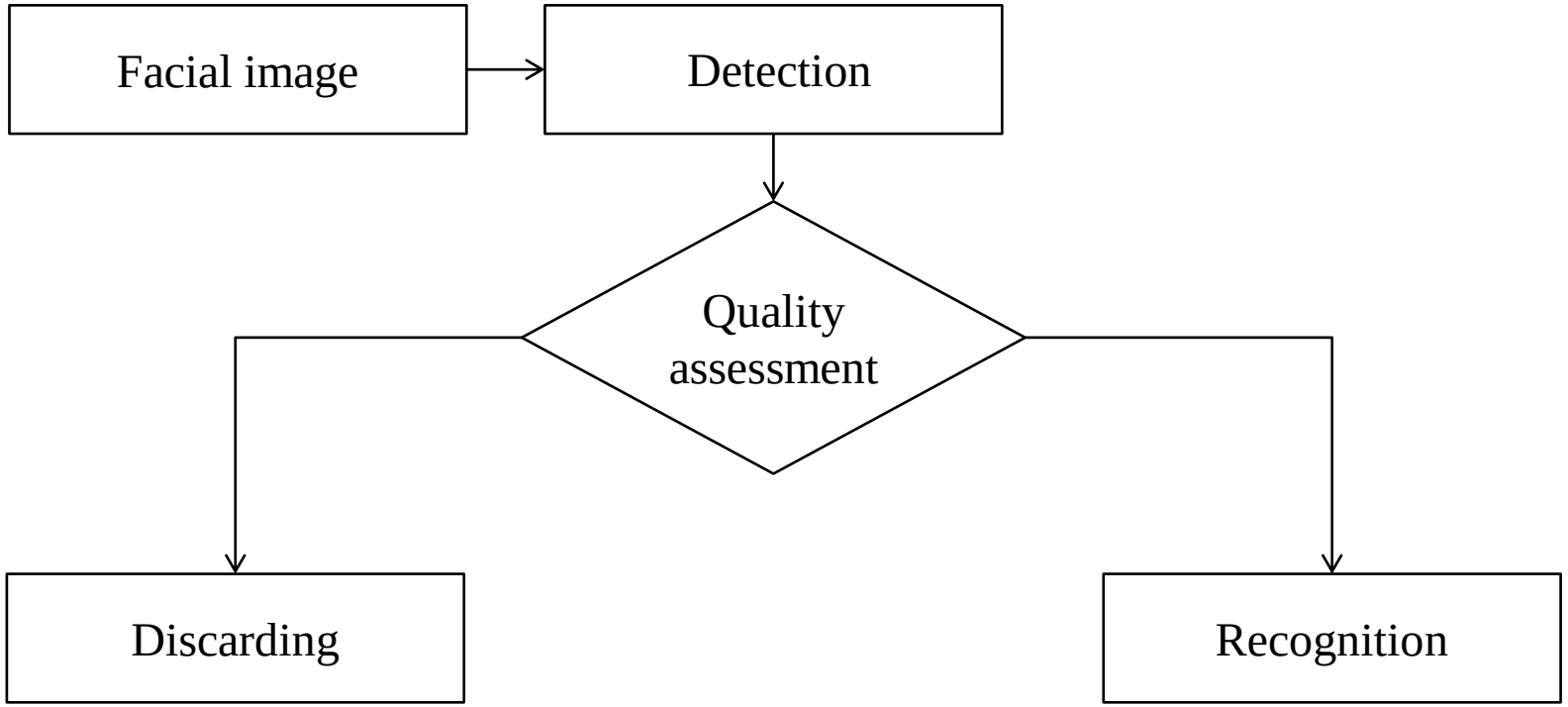
Distorted image (JPEG2000)

Quality assessment algorithms



ITU-R BT.500-11 – methodology for subjective quality assessment tests

Facial identification system



Facial image quality features

Texture

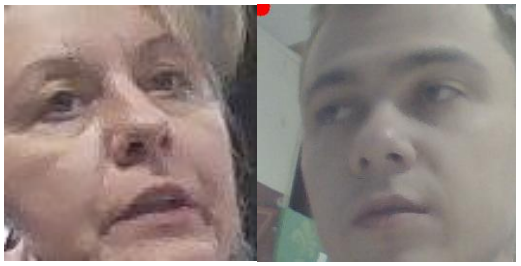
Contrast
Compression ratio
Illuminance

Geometry

Symmetry
Pose
Rotation
Eye visibility

Facial image quality standards:
ISO/IES 19794-5, ICAO 9303

In practice:



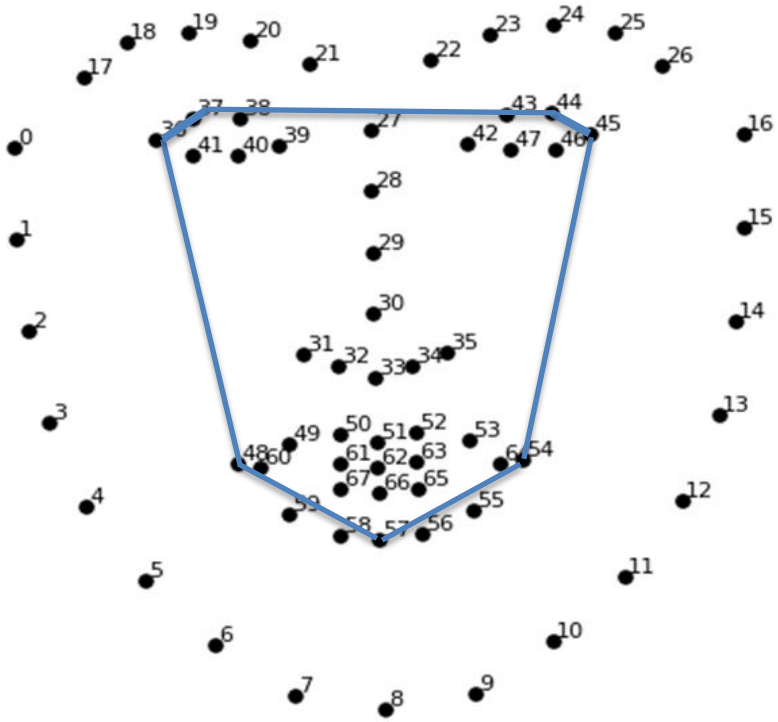
Facial image quality assessment

- Based on learning to rank
- Feature fusion
  - Resolution
  - Sharpness
  - Symmetry
  - Symmetry of landmarks points
  - Other no-reference image quality metrics

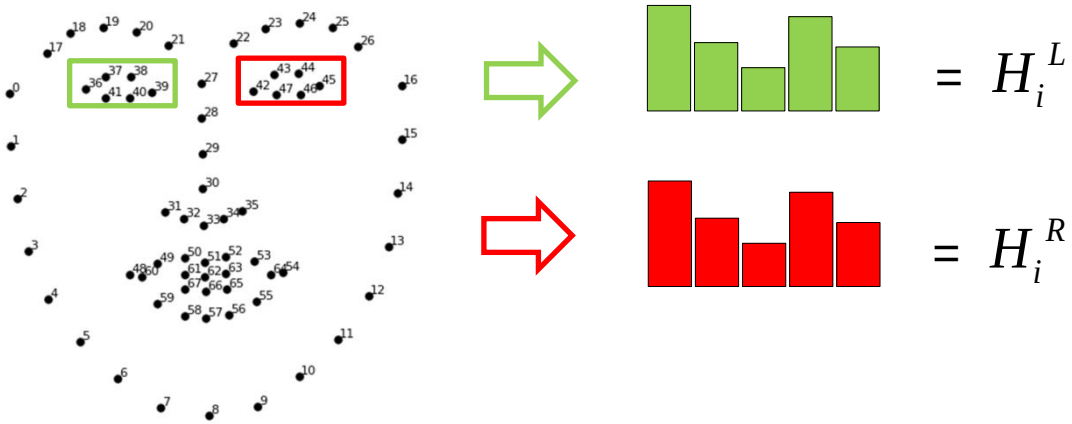
J. Chen, Y. Deng, G. Bai and G. Su, “Face Image quality assessment based on learning to rank”, *IEEE Signal Processing Letters*, vol. 22, № 1, 2015, pp. 90–94.

Sharpness

$$L(I) = \left|\frac{\partial^2 I}{\partial x^2}\right| + \left|\frac{\partial^2 I}{\partial y^2}\right|$$



Symmetry



$$d(i) = \sum_i min(H_i^L, H_i^R)$$

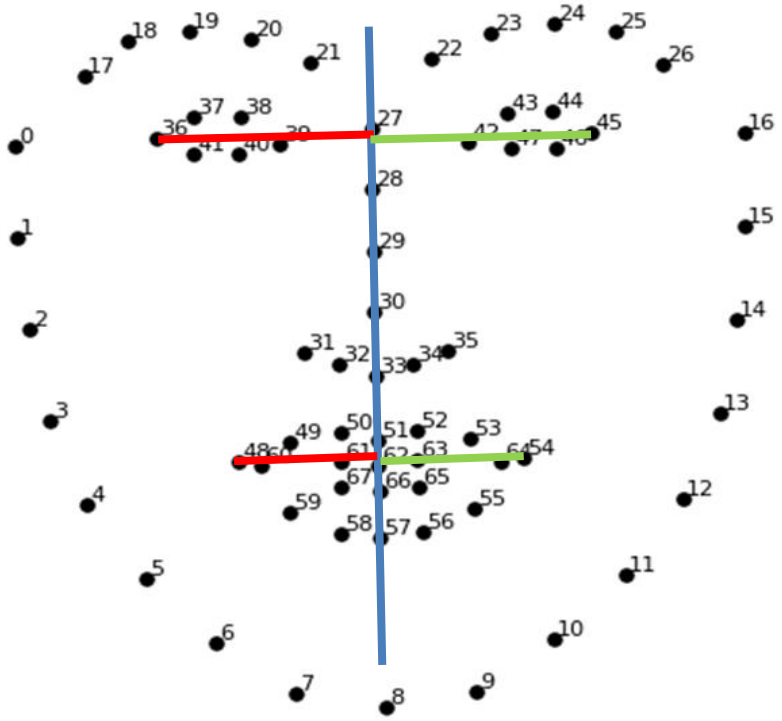
$$S = Symmetry(I) = \frac{1}{N}\sum_{i=1}^{N} d(i)$$

Nikitin M.,Konushin A., Konushin V. Face quality assessment for face verification in video // Proceedings of GraphiCon'2014, 2014. — P. 111–114

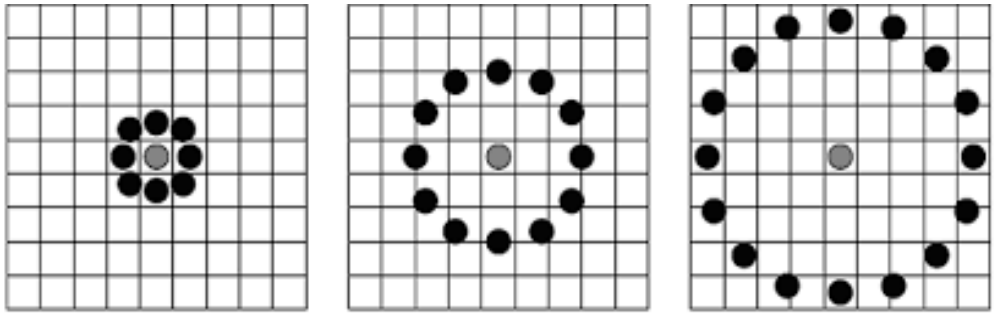
Symmetry of landmarks points

$$S = \frac{|d_{35} - d_{31}| + |d_{42} - d_{39}| + |d_{45} - d_{36}| + |d_{54} + d_{48}|}{w}$$

$$w - \textit{face bounding box width}$$



NRQ LBP



P=8, r=1 P=12, r=2 P=16, r=4

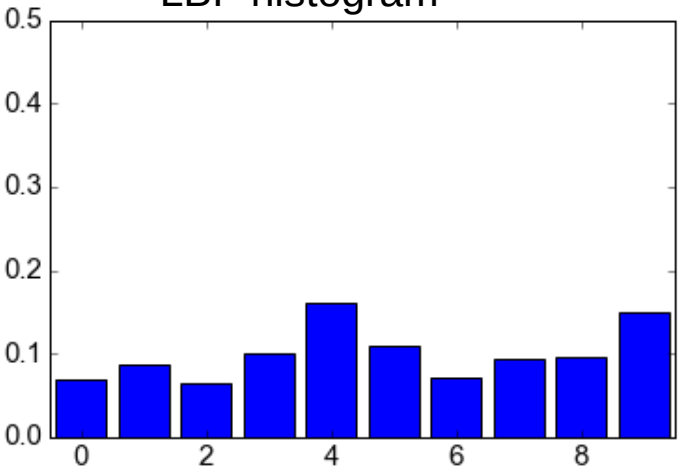
Multiscale universal rotation invariant LBP with: **r = 1, 2, 3; P = 8,16, 24**

I. Nenakhov, V. Khryashchev and A. Priorov, "No-Reference Image Quality Assessment based on Local Binary Patterns", *Proceedings of the 14th IEEE EAST-WEST DESIGN & TEST SYMPOSIUM*, 2016, pp. 529–532.

LBP histogram for distorted image (JPEG)

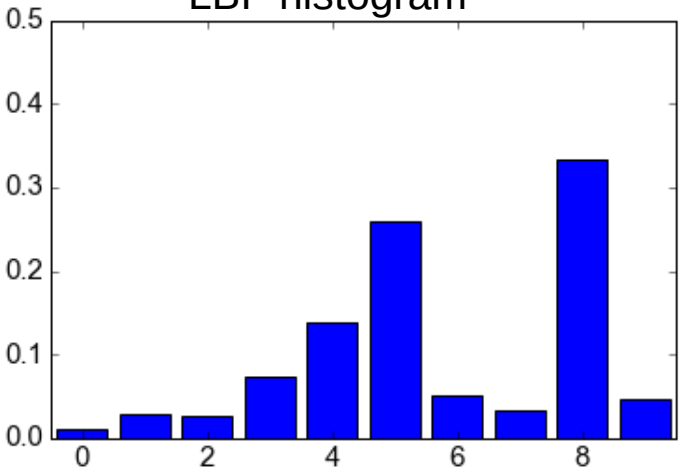
Reference

LBP histogram



JPEG

LBP histogram

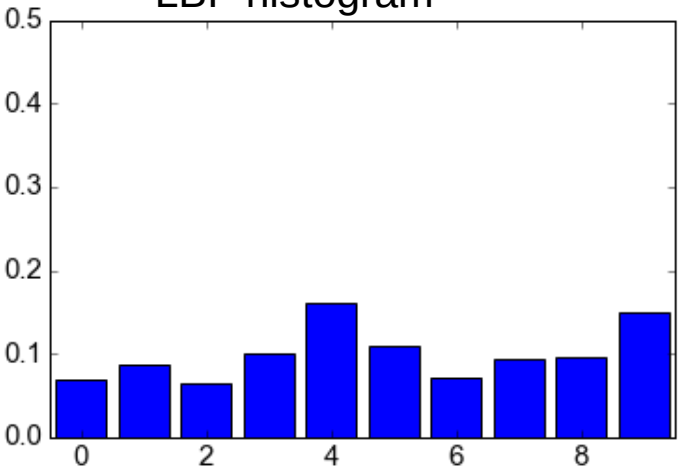


LBP histogram for distorted image (JPEG2000)

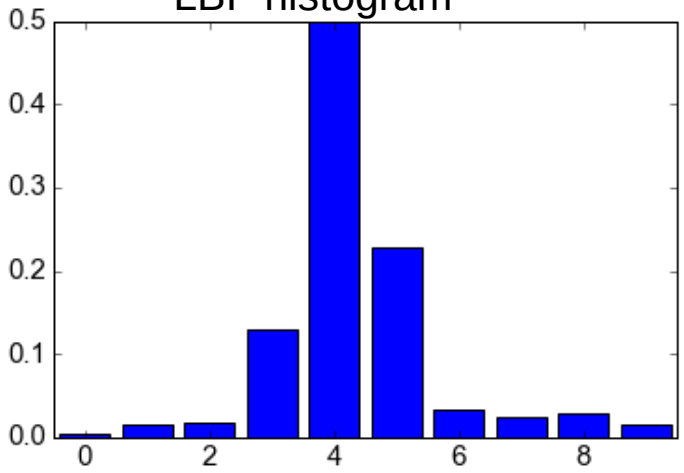
Reference

JPEG2000

LBP histogram



LBP histogram



KFCD dataset

20 lx **130 lx** **180 lx**

10 test video sequences with different lighting conditions

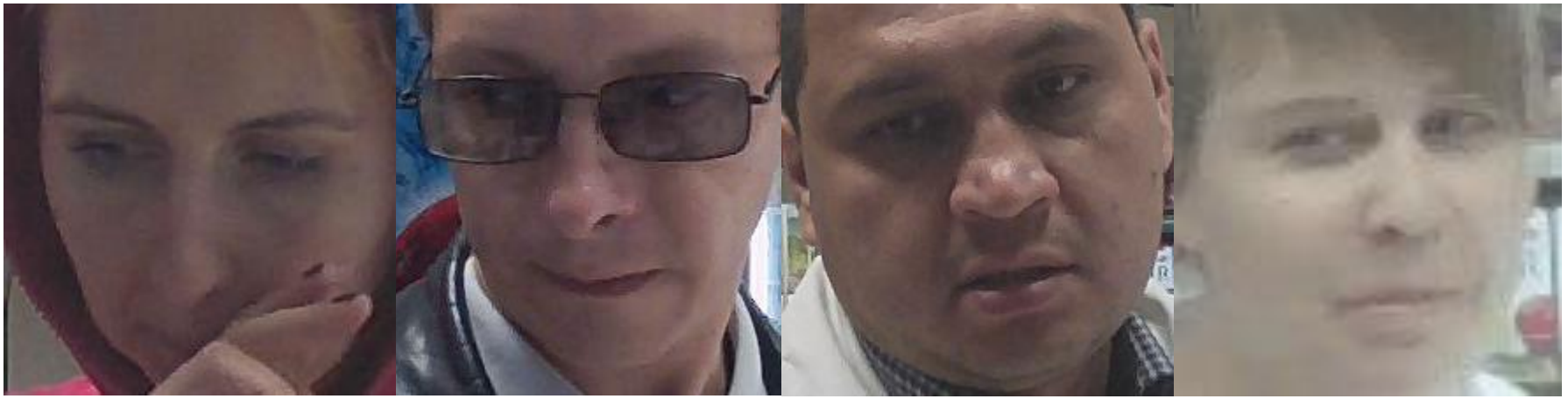
Spearman rank correlation coefficient for FQA metrics

Illuminance, lx	K	Resolution	Sharpness	S	NRQ LBP	BRISQUE	Symmetry
20	0.02	0.40	-0.17	-0.05	0,25	0,33	0.02
50	**0.36**	-0.03	0.03	0.05	-0,13	-0,23	0.15
75	-0.37	-0.09	-0.06	-0.15	-0,004	-0,28	**0.23**
130	0.1	0.36	-0.1	**0.45**	0,33	**0,73**	0.28
180	-0.03	-0.09	-0.21	**0.06**	0,1	-0,25	0.05
500	0.10	-0.15	-0.30	**0.28**	**0,79**	-0,06	0.22

TOP-3 ACCURACY OF FACIAL IMAGE QUALITY METRICS (KFCD DATASET)

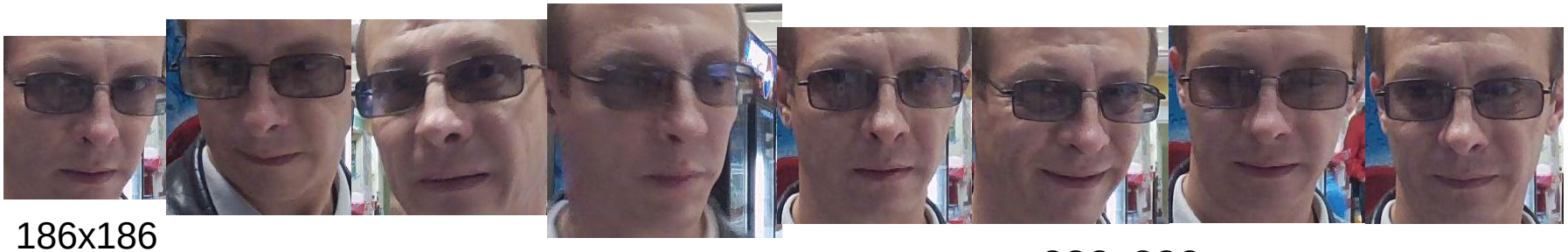
Illuminance, lx	Presence of glasses	K	Resolution	Sharpness	S	NRQ LBP	BRISQUE	Symmetry
20	-	1	1	1	1	0	0	1
20	+	2	0	2	1	0	2	2
50	-	1	1	1	0	0	0	1
50	+	**3**	0	0	2	0	1	2
75	-	1	1	0	2	0	1	0
75	+	2	1	1	1	2	1	0
130	-	2	1	1	1	1	0	0
180	-	**3**	0	1	2	1	0	1
180	+	0	0	0	1	1	1	1
500	+	2	0	0	1	1	0	1
Total		**17**	**5**	**7**	**12**	**6**	**6**	**9**

60PFCD dataset



60 persons
10 image for each person

60PFCD dataset



186x186

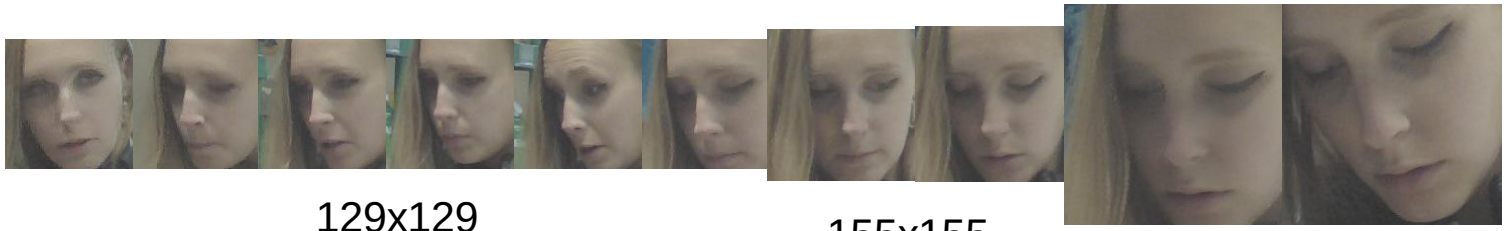
268x267

232x232

108x108

268x268

223x223



129x129

155x155

233x233

Accuracy of FQA metrics on 60PFCD dataset

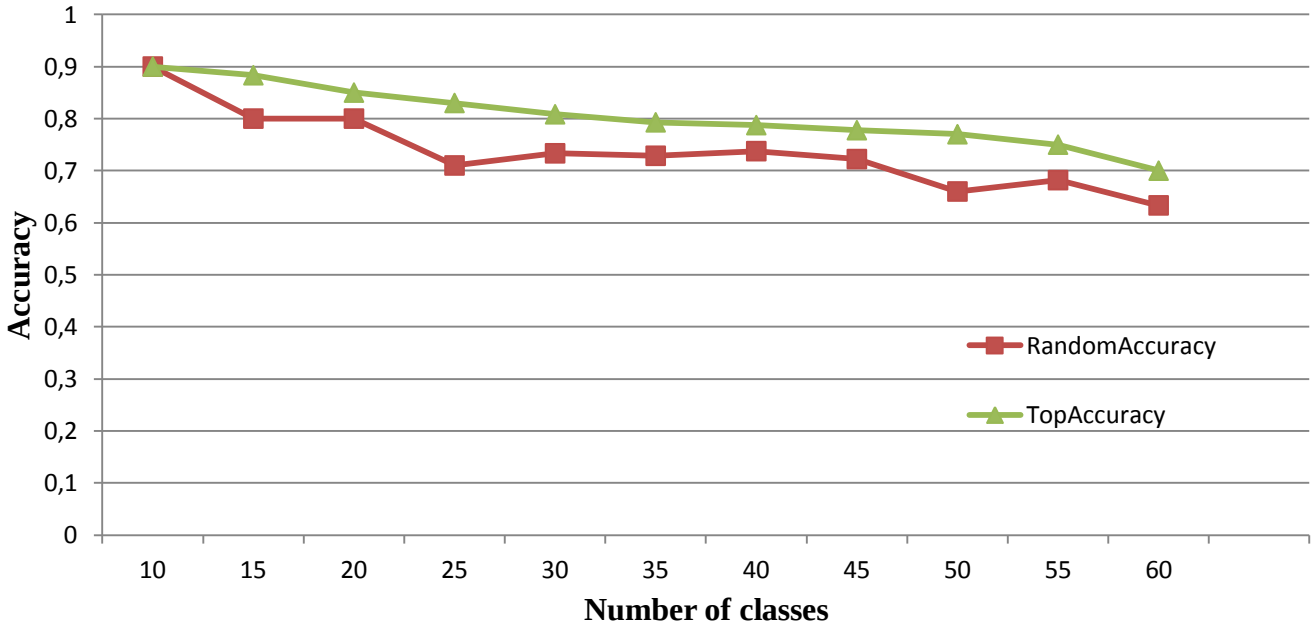
TOP-1 ACCURACY OF FACIAL IMAGE QUALITY METRICS

K	Resolution	Sharpness	S	NRQ LBP	BRISQUE	Symmetry
20	6	7	7	4	7	10

TOP-3 ACCURACY OF FACIAL IMAGE QUALITY METRICS

K	Resolution	Sharpness	S	NRQ LBP	BRISQUE	Symmetry
99	65	60	73	49	52	68

Accuracy of FQA metrics on 60PFCD dataset



Conclusions

- Face image quality assessment metric based on learning to rank has higher top3 accuracy values on 60PFCD and FFCD datasets

- The accuracy of the no-reference NRQ LBP metric depends on the luminance level. It performs well when luminance is more than 100 lx.

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