Unconstrained Facial Expression Recogniton Based on Cascade Decision and Gabor Filters

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INTRODUCTION

BOE

7 facial expression recognition (FER)

Angry Disgust Fear Happy Sad Surprise Neutral

Application

Health care

Class feedback

3D entertainment

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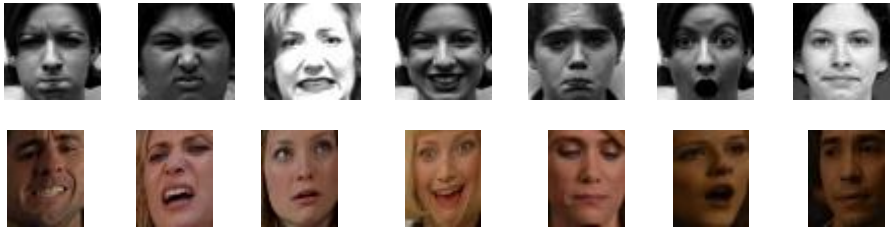
INTRODUCTION

BOE

- Posed Facial Expression and Unconstrained Facial Expression
  - Variation of head pose, illumination, identity bias
  - More applications of unconstrained expression

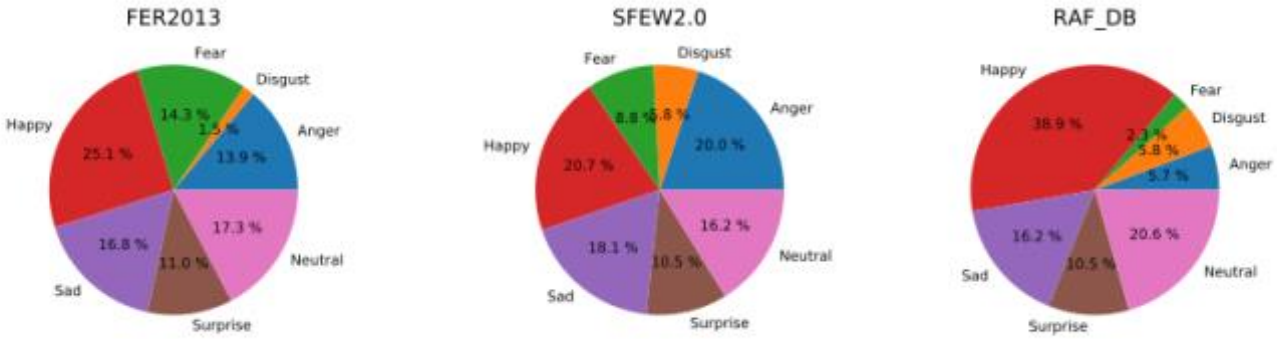


CK+, JAFFE

FER2013，SFEW2.0

INTRODUCTION

- Posed Facial Expression and Unconstrained Facial Expression
  - Lack of sufficient training data
  - Unbalanced data distribution



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INTRODUCTION

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- Posed Facial Expression and Unconstrained Facial Expression
  - Prior arts treat expressions equally in classification
  - $acc(Ha) > acc(Su) > acc(Ne)$.

TABLE I

EXPRESSION RECOGNITION PERFORMANCE OF STATE-OF-THE-ART METHODS FOR FER2013, RAF-DB AND SFEW2.0 RESPECTIVELY.

Dataset	method	An	Di	Fe	Ha	Sa	Su	Ne
FER2013	[7]	69.0	79.4	63.3	90.9	65.4	85.3	74.9
RAF-DB	[10]	71.6	52.2	62.2	92.8	80.1	81.2	80.3
SFEW2.0	[4]	61	4.4	6.4	87.7	38.6	75.6	57.5
Average		67.2	45.3	43.9	90.5	61.4	80.7	70.9

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PROPOSED METHOD

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- An Assumption
  - an expression with a higher accuracy is easier to be recognized when treated equally, and those expressions easier to recognize will hinder the recognition of uneasy expressions.

We think that features of easy expression are dominant in the same classifier

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PROPOSED METHOD

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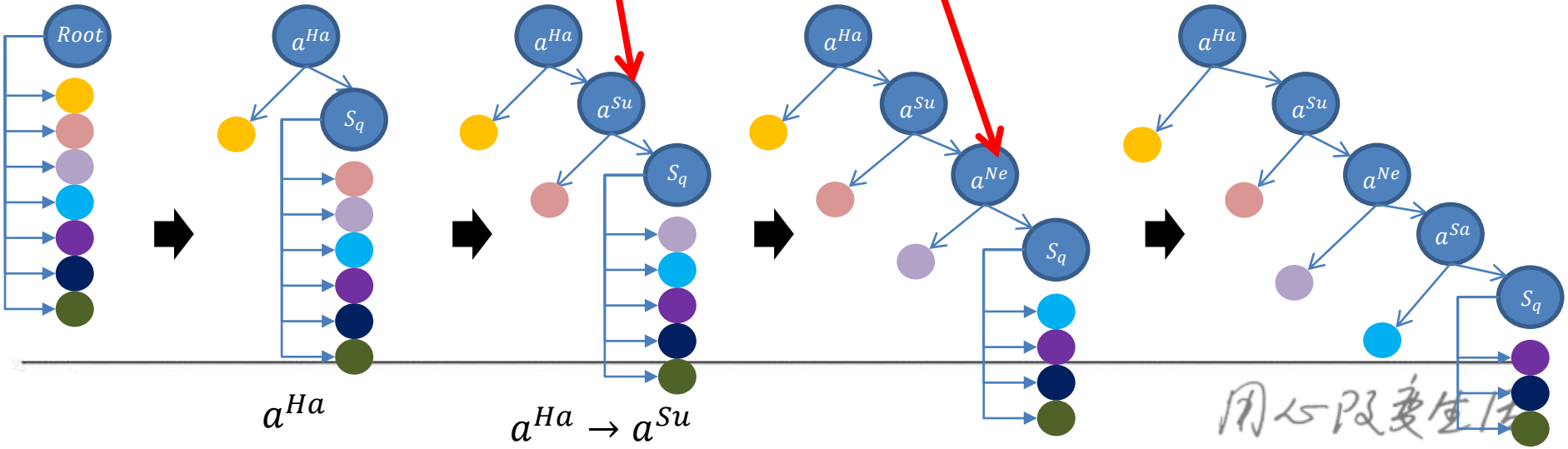
Making Decision Cascadedly

a^{Ha} is binary classifier on the whole dataset for Happy

a^{Su} is on subset for Surprise

a^{Ne} is on subset for Neutral



PROPOSED METHOD

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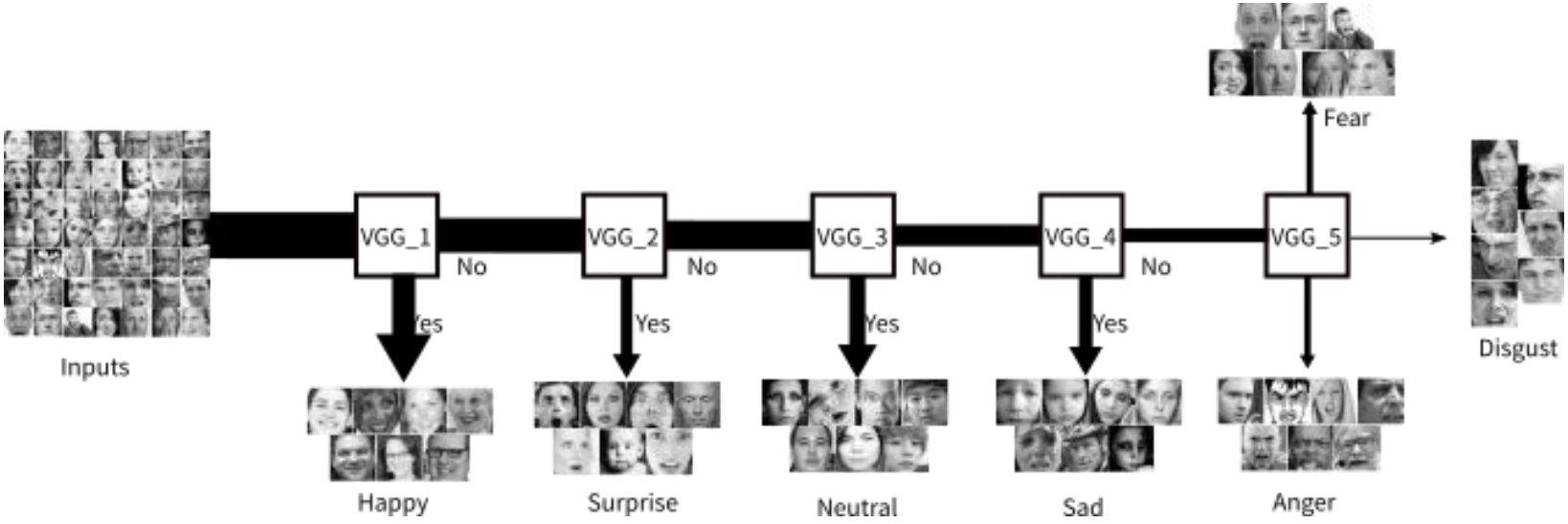
Diagram

- VGG19 network is used as classifier a^{Ha} and et. al.



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PROPOSED METHOD

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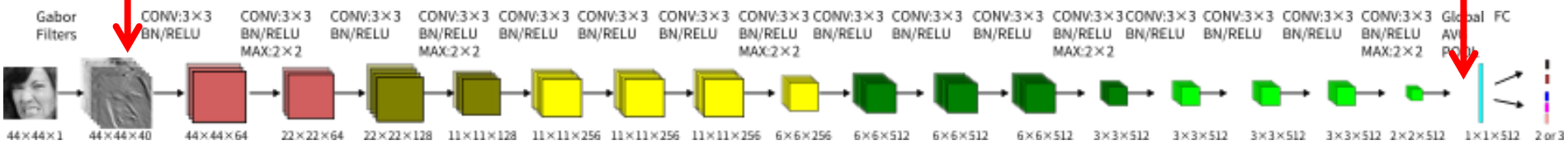
- VGG net
  - VGG 19 layers

Gabor filters used as kernels

Global Average Pooling



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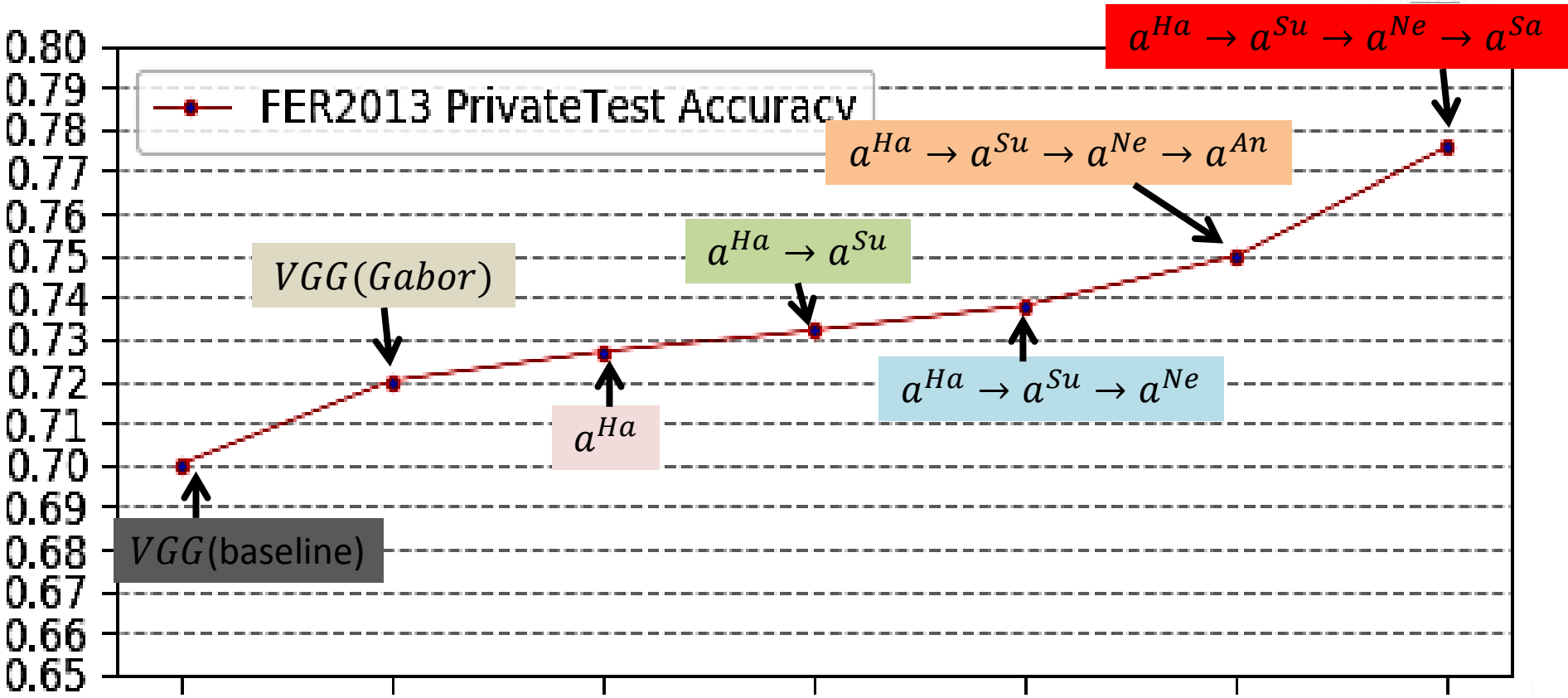
PROPOSED METHOD



PROPOSED METHOD

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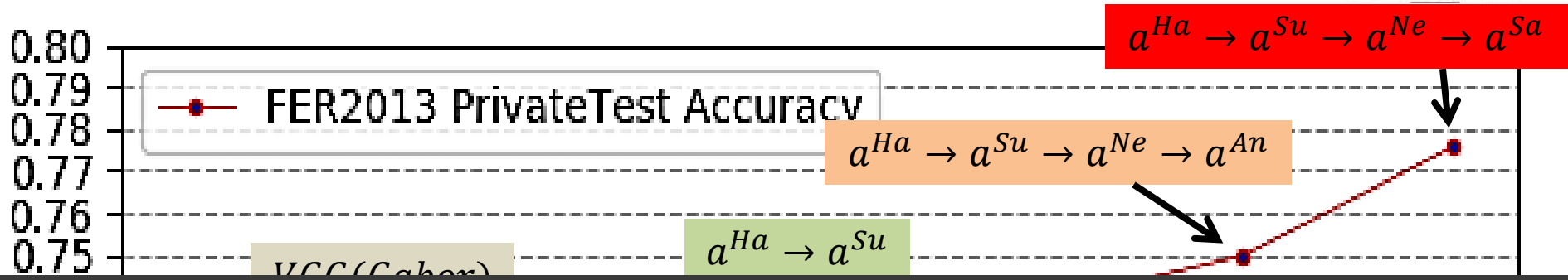

TABLE I

EXPRESSION RECOGNITION PERFORMANCE OF STATE-OF-THE-ART METHODS FOR FER2013, RAF-DB AND SFEW2.0 RESPECTIVELY.

acc(Ha) > acc(Su) > acc(Ne) > acc(An) > acc(Sa) > $acc(Di) > acc(Fe)$

Dataset	method	An	Di	Fe	Ha	Sa	Su	Ne
FER2013	[9]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	85.3	74.9
RAF-DB	[10]	71.6	52.2	62.2	92.8	80.1	81.2	80.3
SFEW2.0	[4]	61	4.4	6.4	87.7	38.6	75.6	57.5
Average		67.2	45.3	43.9	90.5	61.4	80.7	70.9

EXPERIMENT RESULTS

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- Unconstrained facial expression datasets
  - FER2013, RAF-DB, SFEW2.0

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		An	Di	Fe	Ha	Sa	Su	Ne	Average	Accuracy
FER2013	Kim et al. [8] in *CVPR Workshop* 2016	-	-	-	-	-	-	-	-	73.7
	Kim et al. [6]	-	-	-	-	-	-	-	-	72.7
	Pramerdorfer et al. [9] in *CVPR* 2016	-	-	-	-	-	-	-	-	75.2
	Georgescu et al. [13] in *IEEE Access* 2019	-	-	-	-	-	-	-	-	75.42
	Zhang et al. [7] in *ICCV* 2015	69.0	79.4	63.3	90.9	65.4	[illegible]	[illegible]	75.6	75.1
	mini-Xception (baseline)	60	55	41	87	53	[illegible]	[illegible]	64.1	66
	VGG-19 (baseline)	60	67	54	89	57	[illegible]	[illegible]	68.3	70
	one-vs-the-others (baseline)	64	0	15	87	44	76	54	48.6	60.7
	VGG-19 w.t. Gabor	62	56	47	89	62	83	73	67.4	72
	a^{Ha}	62	65	51	88	71	8[illegible]	[illegible]	70.1	72.7
	$a^{Ha} \rightarrow a^{Su}$	65	72	58	88	81	75	[illegible]	73.9	73.2
	$a^{Ha} \rightarrow a^{Su} \rightarrow a^{Ne}$	67	37	60	93	78	73	69	68.1	73.8
	$a^{Ha} \rightarrow a^{Su} \rightarrow a^{Ne} \rightarrow a^{An}$	83	65	85	85	56	83	61	74	74.98
	$a^{Ha} \rightarrow a^{Su} \rightarrow a^{Ne} \rightarrow a^{Sa}$	84	70	75	85	76	73	69	76	77.6
RAF-DB	Li et al. [10] in *CVPR* 2017	71.6	52.2	62.2	92.8	80.1	81.2	80.3	74.3	-
	Kuo et al. [11] in *CVPR Workshop* 2018	74.5	67.6	46.9	82.3	58	84.6	59.1	67.6	-
	mini-Xception (baseline)	75	37	50	89	76	83	72	68.9	78.3
	VGG-19 (baseline)	84	0	0	89	86	87	78	60.6	78
	VGG-19 w.t. Gabor	81	57	0	96	86	86	89	70.7	86
	$a^{Ha} \rightarrow a^{Su} \rightarrow a^{Ne} \rightarrow a^{Sa}$	77	86	54	90	93	81	84	80.7	86.5
SFEW2.0	Yu et al. [4] in *ICMI* 2015	61	4.4	6.4	87.7	38.6	75.6	57.5	47.3	56
	Kim et al. [6]	63.8	0	17.1	85.3	49.1	64.9	58.6	48.4	53.9
	Liu et al. [21] in *CVPR* 2017	66.2	4.4	6.4	87.7	40.4	73.3	57.5	48	54.2
	Ding et al. [22] in *FG* 2017	42.9	100	10	71.7	29.5	43.9	28.5	46.6	55.2
	Results on FER2013	84	5	30	88	94	2	9	44.6	56.2
	Results on RAF-DB	90	43	7	79	89	5	78	55.9	64.8

No Gabor

Gabor

FER Result Examples

Fear

Happy

Sad

Surprise

Neutral

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Thanks!

Q&A

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