

Winner at ICCV 2017 Real versus Fake expressed emotions challenge

Discrimination between genuine versus fake emotion  
using **long-short term memory with parametric bias**  
and **facial landmarks**

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# Human and chimpanzee imitate other's action !



**Infant imitates his mother's action**



**Chimp imitates human's action**

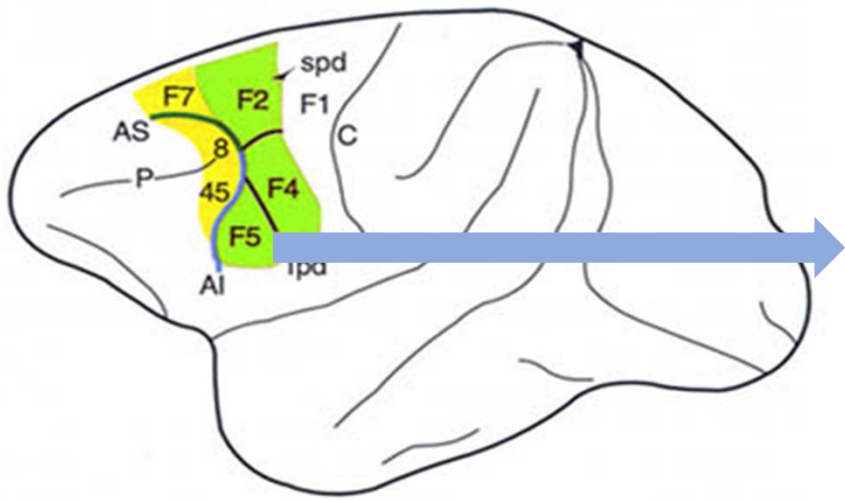
# Dataset for the fake emotion detection challenge

(Wan et al, 2017 ICCV Fake Emotion Workshop)

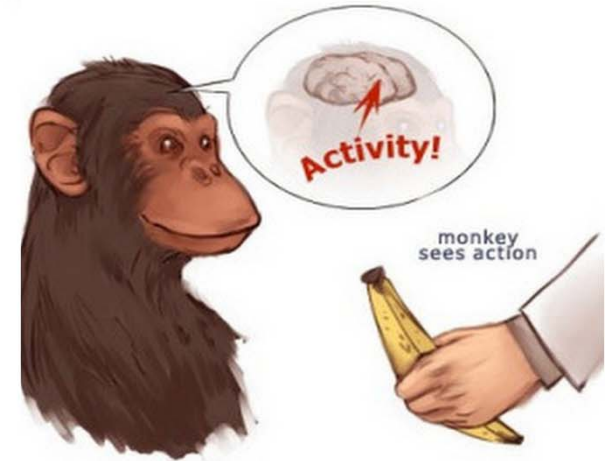


- For the genuine emotion set, subjects were supposed to express the same emotion which was provoked by the shown video: ***mirroring***
- For the fake emotion set, the expressed emotion and stimulated emotion were contrasted: ***masking effect***

**Mirror neurons (Rizzolatti, 2004):** Neurons in area F5 fire either when he moves his hand or when he just watches such action.

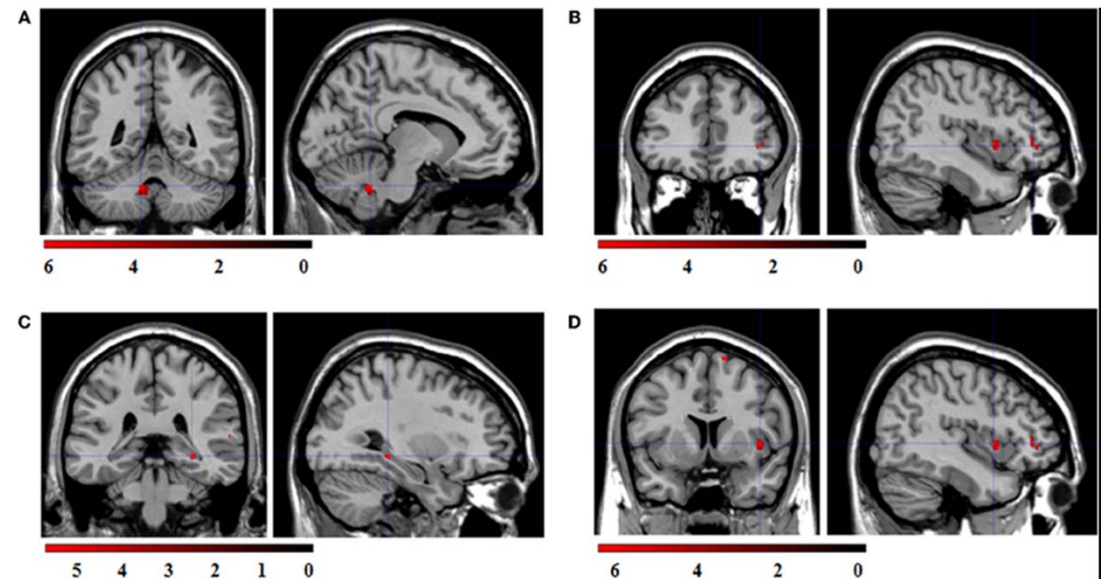


**Move his hand**

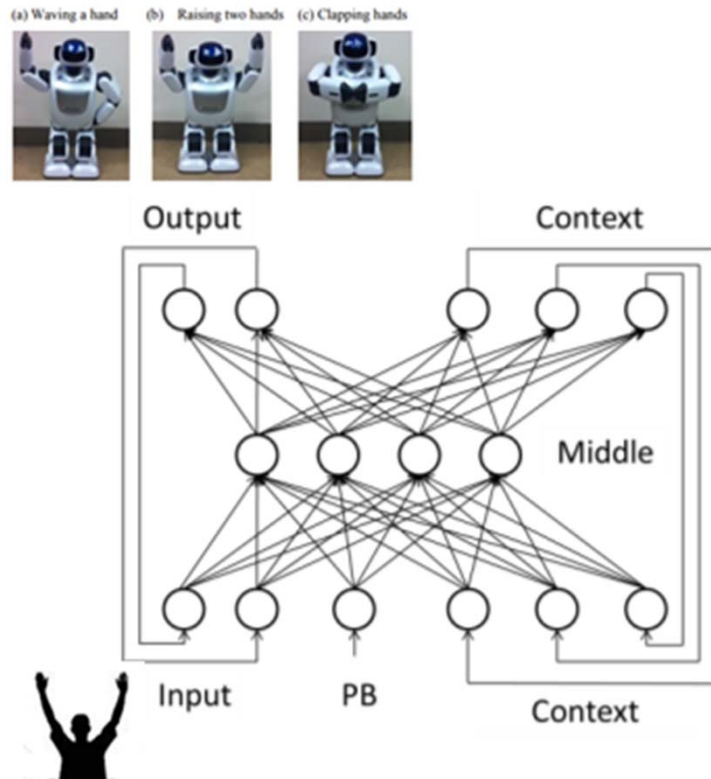


**Watch such action**

# Relationship between Mirror Neuron and Facial Expression (Likowski et al, 2012)

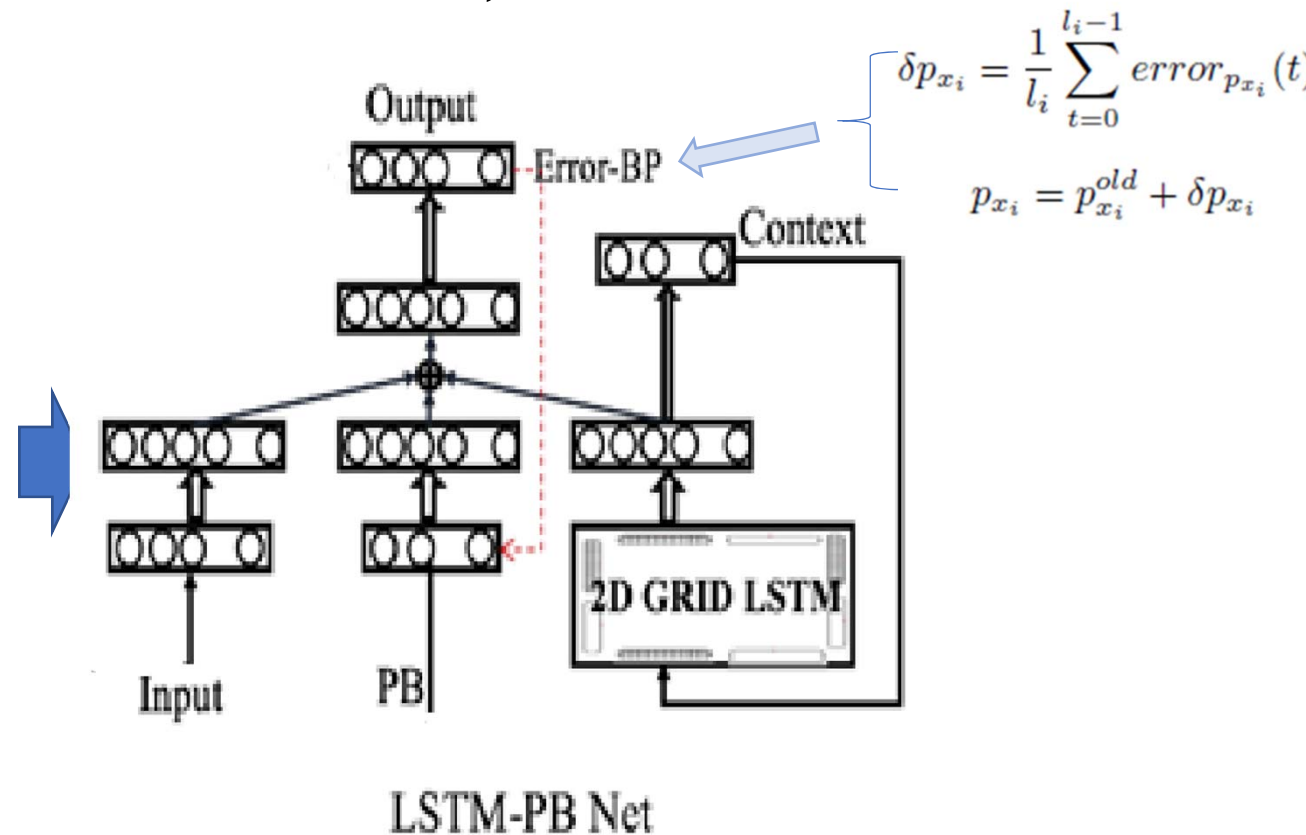


# Mirror Neuron modeling: RNN-PB(Parametric Bias)-> LSTM-PB



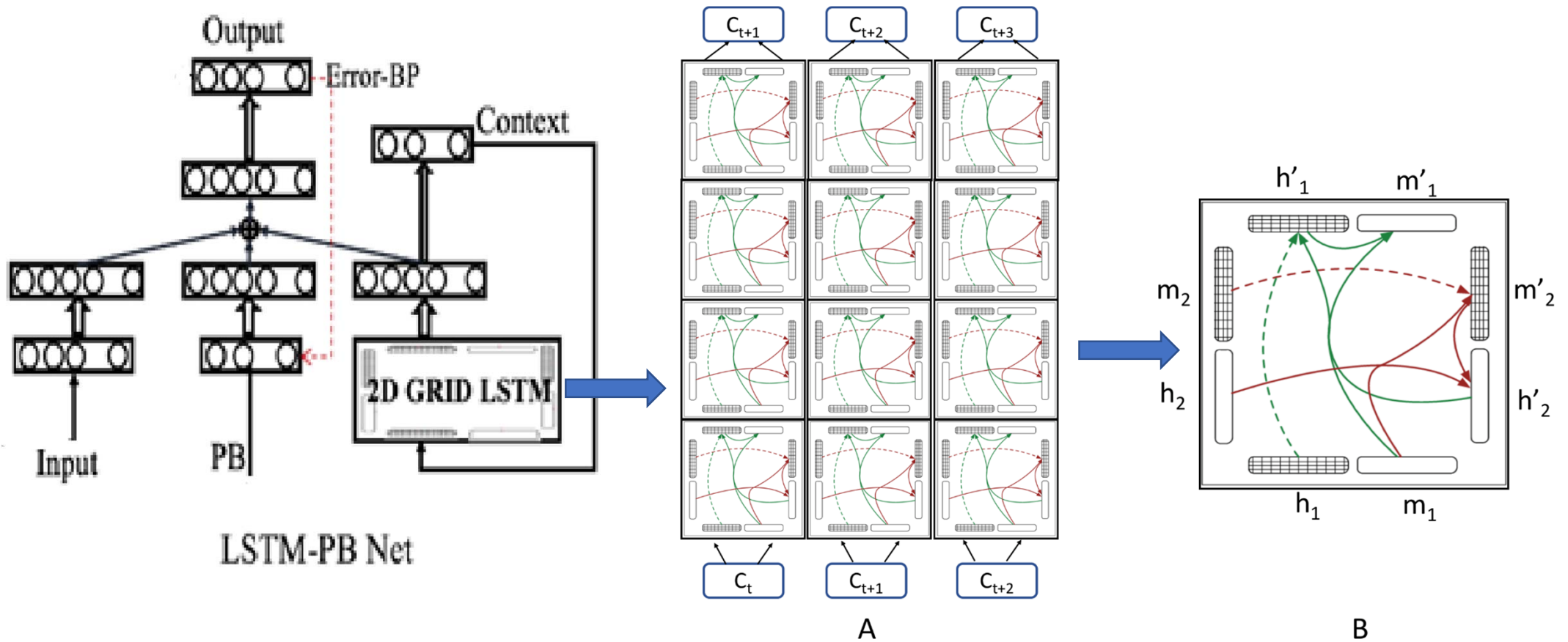
RNNPB proposed by Tani et al.

**Movement Imitation Task**



**Recognition of Fake Emotion**

# 2D GRID-LSTM (Kalchbrenner et al, 2015)



# Training and Recognition using LSTM-PB

## ➤ Training Mode

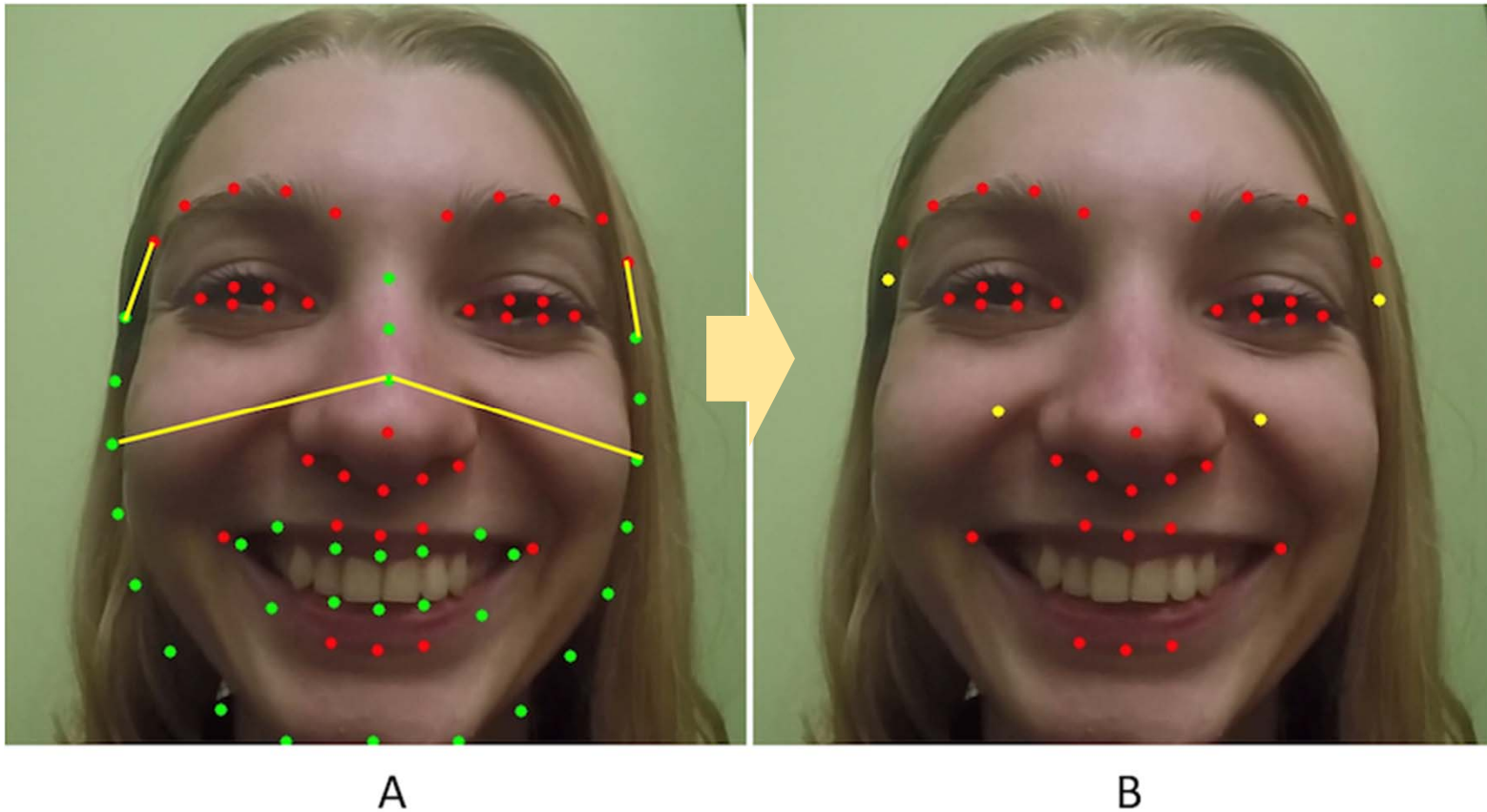
1. Train the network using the labeled data by adjusting the weights
2. Boil down to 2 parametric biases: (1) fake and (2) genuine emotion

## ➤ Recognition Mode

1. Computes a PB vector that matches with the pre-trained one
2. Prediction error is back-propagated to the PB vector in term of MSE
3. No weights change during this mode

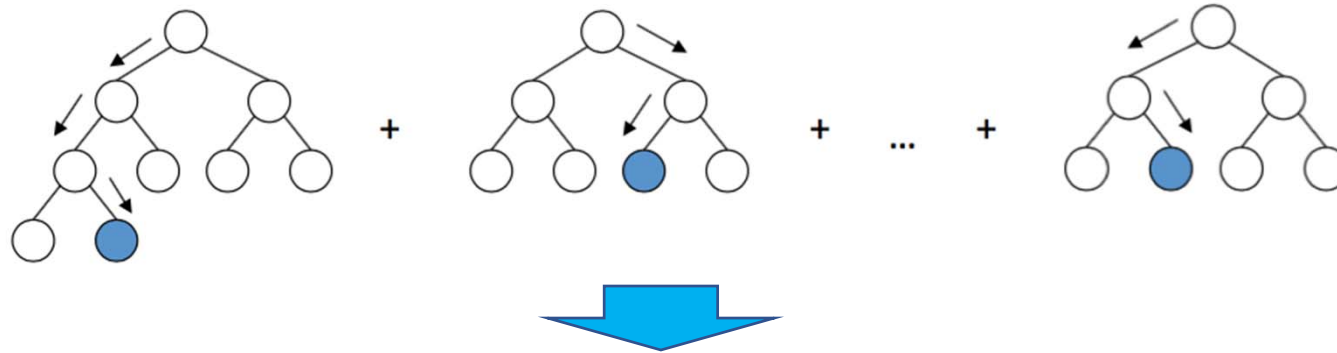
# Facial Landmarks Detection using D-lib

**68 -> 40 facial landmarks by removing chin, nose, inner mouth areas**

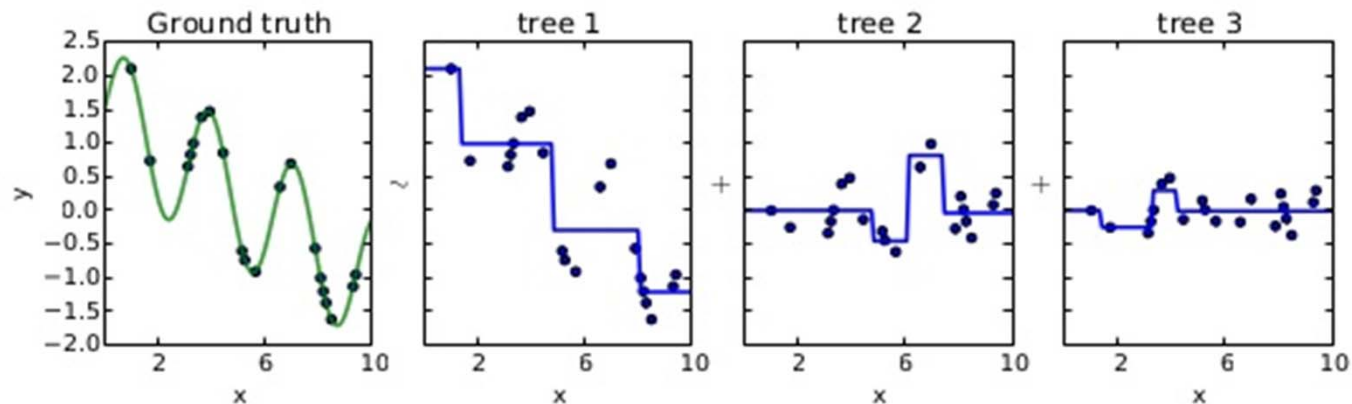


# Greedy Gradient Boosting (J. Friedman, 2001): Binary Discrimination (fake or genuine)

## Tree-based Regression



## Residual fitting



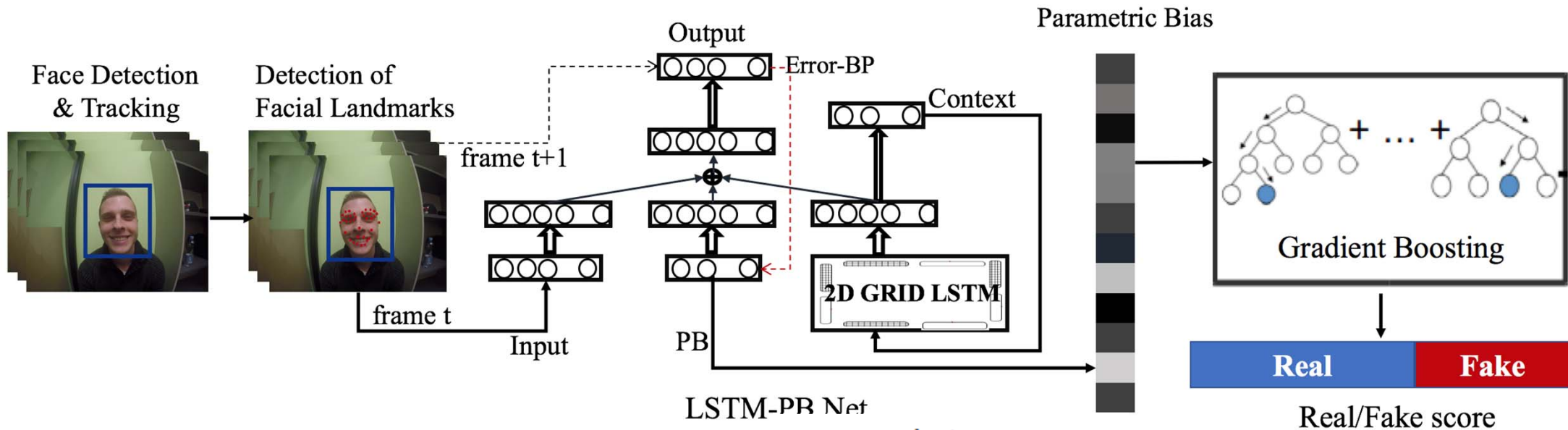
# Our Pipeline

AdaBoost

D-lib Landmarks

RNN-PB + 2D GRID LSTM

GBM-based binary classifier



$$\delta p_{x_i} = \frac{1}{l_i} \sum_{t=0}^{l_i-1} error_{p_{x_i}}(t)$$

$$p_{x_i} = p_{x_i}^{old} + \delta p_{x_i}$$

# Experiment and Result

Data	Number of labels	Number of videos	Number of subjects	Labels provided
Training	12	480	40	Yes
Validation	12	60	5	No
Testing	12	60	5	No

Table 1. The summary of the dataset.

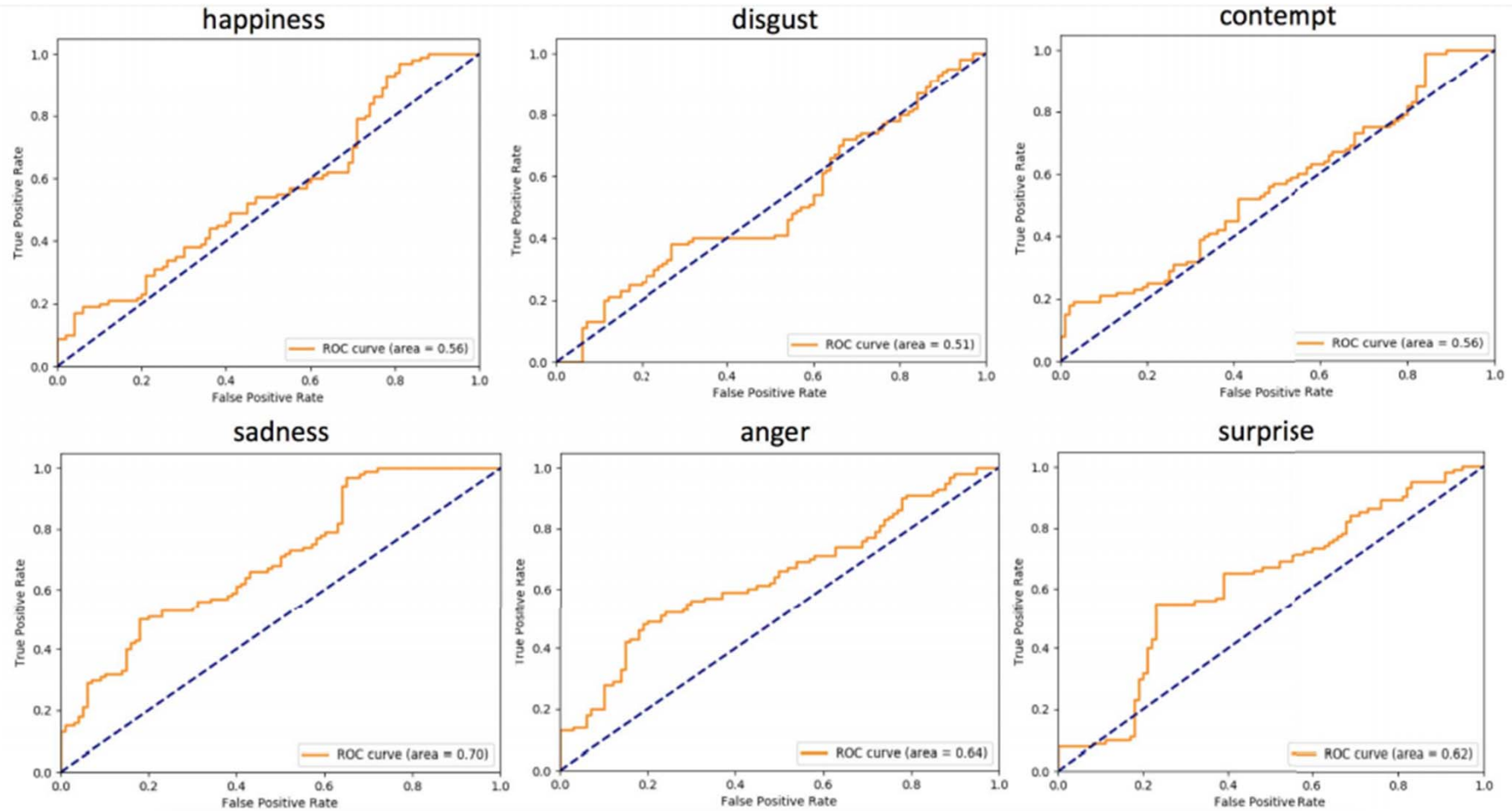
Rank	Team	accuracy (%)
1	NIT-OVGU	76
2	<b>HCILab (ours)</b>	71
3	innovwelt	63
4	TUBITAK UZAY-METU	61
5	faceall Xlabs	58
6	ICV Team	53
7	BNU CIST	53

Table 2. Development results. Ours is second one.

	Rank	Team	accuracy (%)	SD
	1	<b>HCILab (ours)</b>	<b>66.7</b>	<b>18.8</b>
	1	NIT-OVGU	66.7	24.8
	3	TUBITAK UZAY-METU	65	
	4	BNU CIST	61.7	
	5	faceall Xlabs	51.7	

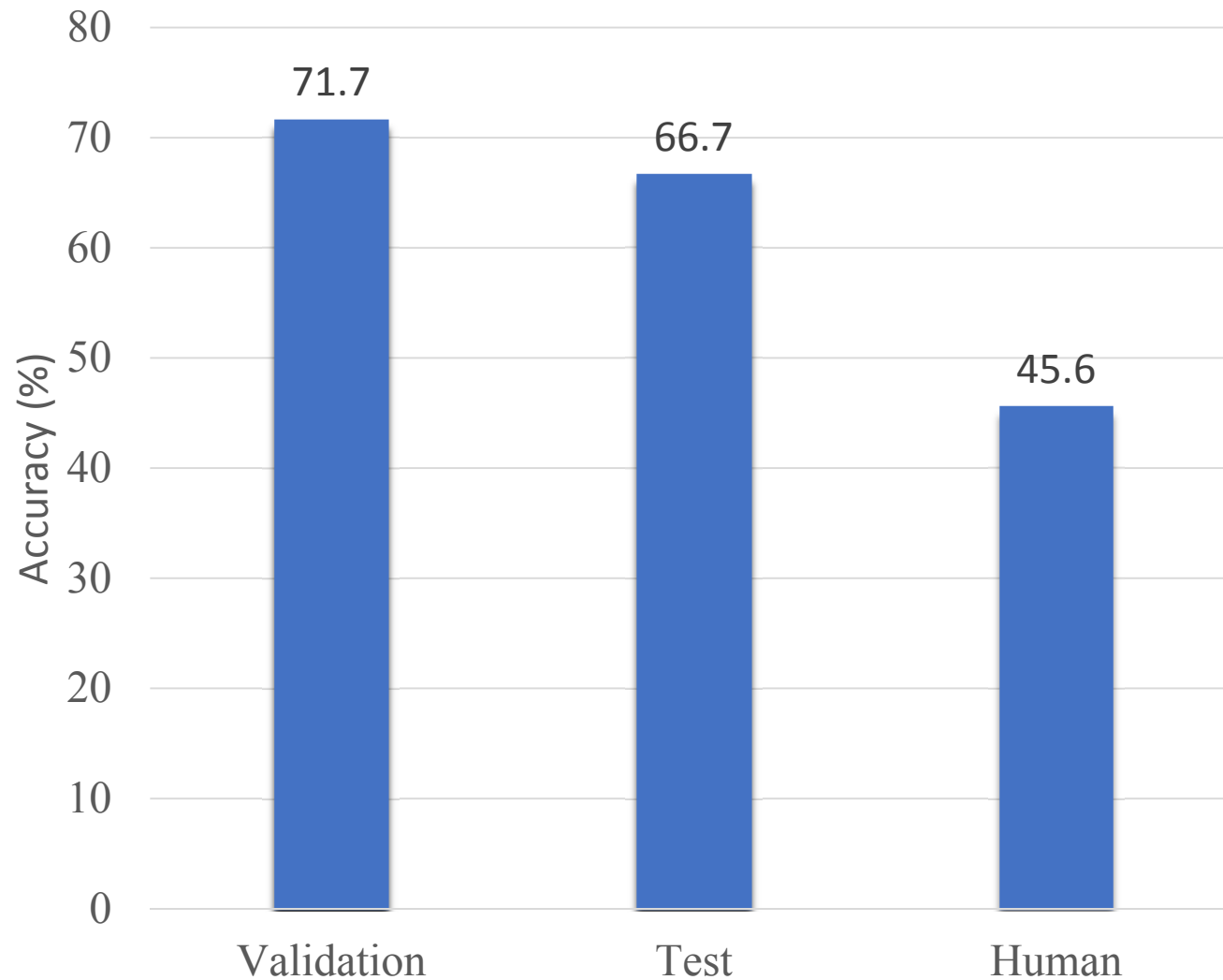
Table 3. Final results. Ours is the first place with another team.

# Experiment and Result



The ROC curves for six emotions.

# Comparison between human and algorithm



# Conclusion

- **Mirror neurons system** has been a major issue in neuroscience.
- Evidences suggest that it is closely related with **facial expression**.
- A **deep neural network version** of the mirror neuron model is proposed.
- It transforms a group of the facial landmarks into **emotion authenticity**.
- This system **outperforms human** in the fake emotion discrimination.
- It is believed that fake emotion discrimination has diverse potential applications such as **telling how good an actor is in the movie** or **judging a suspect whether he is telling the truth or not**.