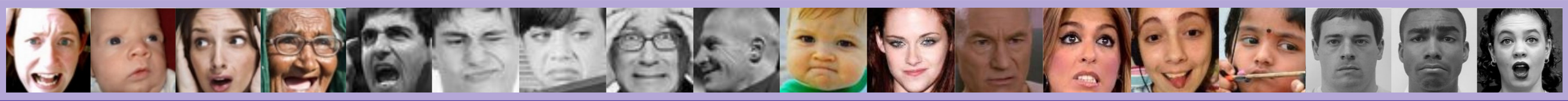


Ensembles with shared representations

achieve human-level performance on facial expression recognition with a **low computational cost**.

Efficient Facial Feature Learning with Wide Ensemble-based Convolutional Neural Networks

Henrique Siqueira, Sven Magg and Stefan Wermter

Knowledge Technology, University of Hamburg, Germany

Ensemble Methods:

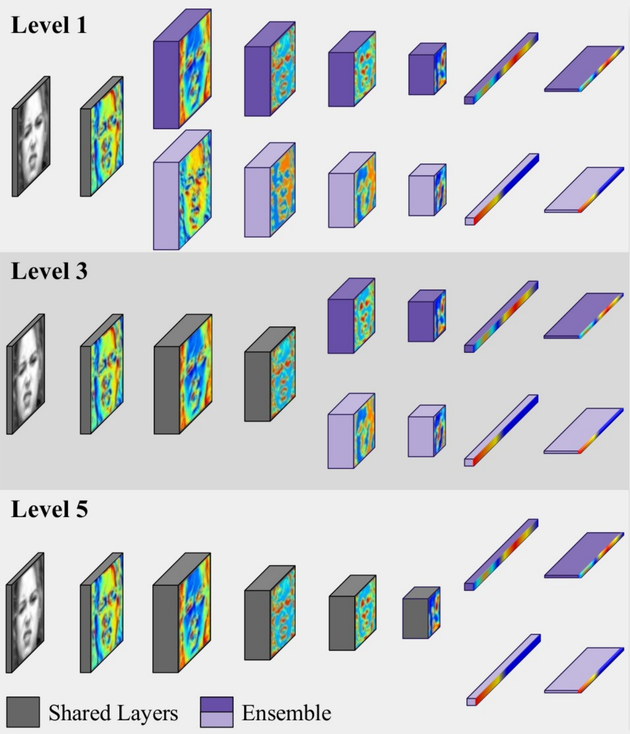
- Have proven to be efficient for reducing remaining residual generalization error.
- Are suitable for real-world applications due to their robustness and accuracy.

Ensembles with Shared Representations:

- Shared layers are responsible for the reduction of redundancy, training and inference time.
- Convolutional branches learn complementary visual representations from data.
- Inductive transfer learning from a combined loss under a multitask learning setup.

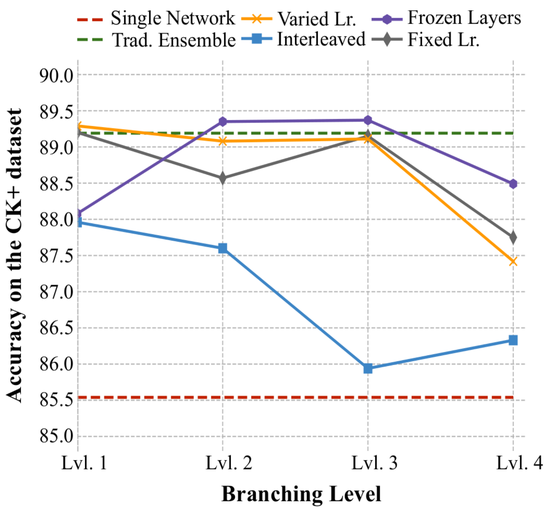
Problems with Ensembles of Deep Neural Networks:

- Costly training.
- High redundancy.
- Inefficient data processing.



Results:

- Efficient transfer learning and data processing.
- Robust against unbalanced distributions.
- Outperformed state-of-the-art methods on in-the-wild benchmarks of facial expressions.



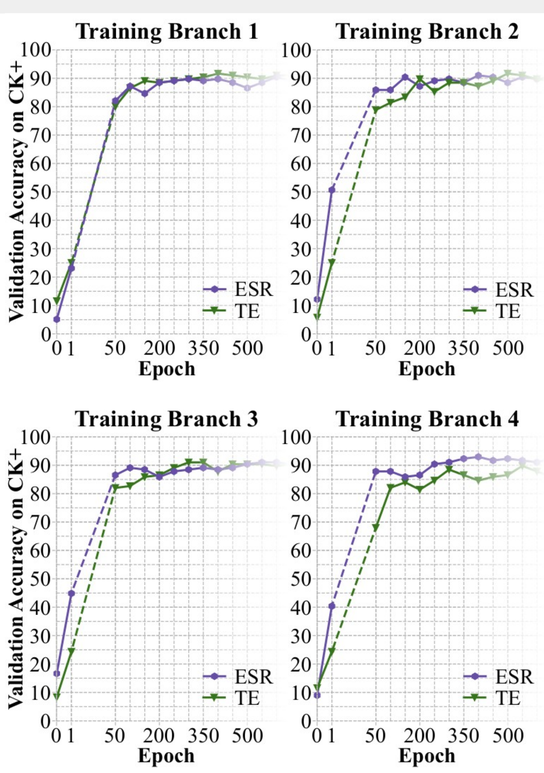
Approach	#	Accuracy
Single Network	**131.208**	$85.5 \pm 3.5\%$
Traditional Ensemble	524.832	$89.2 \pm 1.2\%$
ESR-4 Lvl. 3	355.104	$\mathbf{89.4 \pm 2.2\%}$
ESR-4 Lvl. 4	243.936	$88.5 \pm 3.8\%$

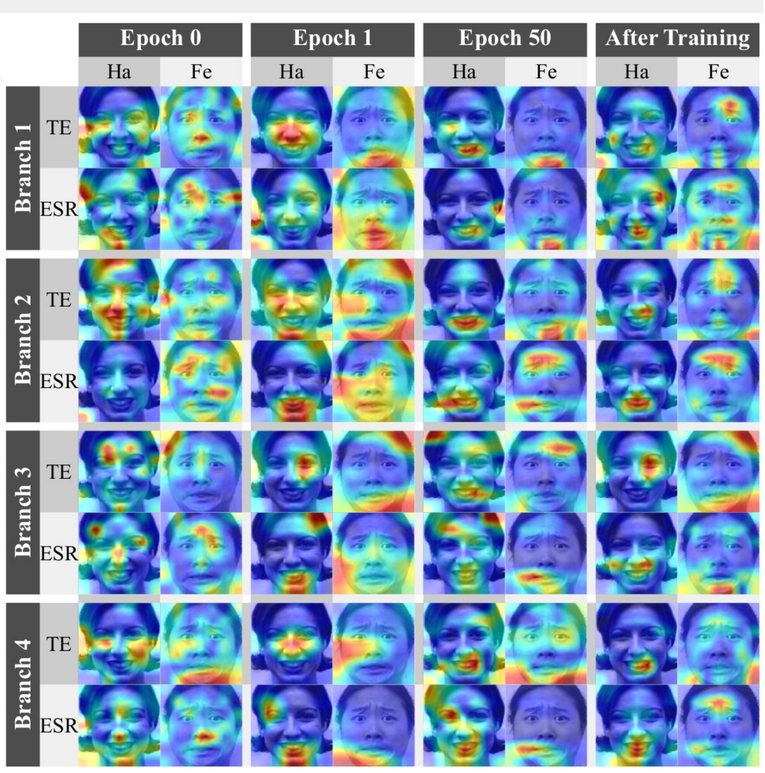
	TE	**Lvl. 3**	Lvl. 4
Single Network	0.004 ✓	**0.005** ✓	0.043 ✓
Trad. Ensemble (TE)	–	**0.956** ✗	0.614 ✗
Lvl. 3	–	–	0.514 ✗

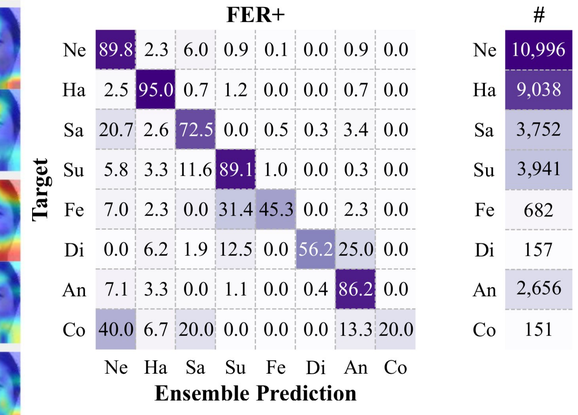
Approach	#	Acc ↓
ESR-9 (Our network)	**8**	**59.3%**
AlexNet-WL (Mollahosseini et al. 2019)	8	58.0%
VGGNet (Hewitt and Gunes 2018)	8	58.0%

Approach	RMSE	
	Aro ↓	Val
ESR-9 (Our network)	**0.33**	**0.36**
VGGNet (Hewitt and Gunes 2018)	0.37	0.41
MobileNet (Hewitt and Gunes 2018)	0.38	0.42

Approach	Acc ↓
ESR-9 (Our network)	$\mathbf{87.15 \pm 0.1\%}$
VGG16-PLD (Barsoum et al. 2016)	$84.99 \pm 0.37\%$
VGG16-CEL (Barsoum et al. 2016)	$84.72 \pm 0.24\%$







Knowledge Technology

SOCRATES Social Cognitive Robotics in The European Society