### Research of Facial Expression Recognition Based on Deep Learning

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### Introduction

- This paper proposes a CNN based deep learning model for facial expression recognition named FERNet.
- Depth wise separable convolution model.
- Includes 4 residual depth-wise separable convolutional layers and 1 standard convolutional layers.
- Achieves accuracy of 71.9% on real world expression dataset.

### Problem:

- Only 7% of total information is expressed in language, and 38% is communicated through auxiliary language, such as rhythm, voice and intonation and the largest proportion is facial expression, reaching 45% of the total.
- Facial Recognition has various application like in medication for initial analysis if person is not able to speak, carrying out the psychological analysis etc. Researchers are working in the domain to make it useful in the industry.

## Solution Proposed in the Paper:

- Authors proposed a depth-wise CNN model named FERNet for facial expression recognition.
- Reduces the computations by (1/N + 1/D<sup>2</sup>)
- Depthwise Convolution: Filtering Stage, Pointwise Convolution: Combination Stage
- Applies convolution to single input channel.
- If the number of neurons are 64 in convolution layer, then in standard convolution, we transform image 64 times but in DC, we transform image once and then elongate it 64 times







Figure 3. Depth-wise separable convolutions

# Structure of FERNet



### Model Architecture:

- Contains 4 depth wise separable convolutions and residual modules.
- Each of which includes 3 depthwise convolution layer and 1 standard convolution layer.
- Batch Normalization layer added after each convolution to normalize the data.
- Used Global Average Pooling(GAP) instead of max pooling layer which reduces the parameters and alleviates the overfitting.
- Softmax activation layer to produce prediction.
- Adam Optimizer with basic learning rate of 0.01 and batch size of 32

### Dataset

- Karolinska Directed Emotional Faces (KDEF) for training and Real- World Affective Faces(RAF) for experiments.
- KDEF contains set of pictures of 70 individuals (35 males and 35 females) who displayed 7 different emotional expressions from 5 different angles.
- RAF contains 30000 great diverse facial images and has two different subsets: 7 classes of basic emotions and 12 classes of compound emotions.
- Divided dataset in 8:1:1 manner as training, validation and testing.

Expression Category	Dataset	
	RAF	KDE F
Anger	78.3%	92.5%
Disgust	63.2%	96.1%
Afraid	64.4%	86.%
Happiness	84.4%	98.6%
Sadness	69.3%	92.6%
Surprise	79.9%	95.5%
Neutral	63.8%	94.3%
Average	71.9%	93.7%

#### Experimental Results