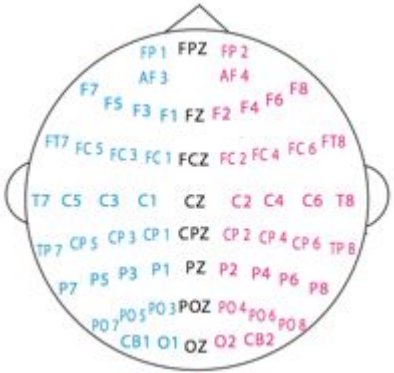
How a Machine Learned to Recognize Human Emotions

By: Omar Ozgur

The Study

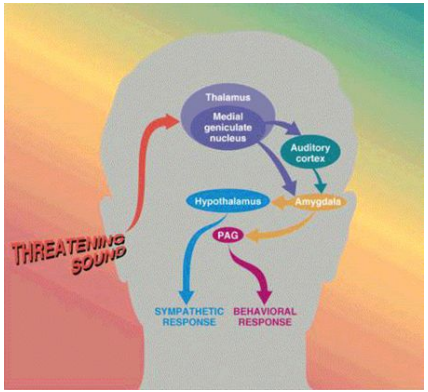
- A study done at Shanghai Jiao Tong University
- 15 students watched 15 videos
- 62 electrodes recorded brain activity
- Students rated clips as positive, negative, or neutral
- Level of emotional arousal was rated between 1 and 5

No.	Labels	Film clips sources	#clips
1	negative	Tangshan Earthquake	2
2	negative	Back to 1942	3
3	positive	Lost in Thailand	2
4	positive	Flirting Scholar	1
5	positive	Just Another Pandora's Box	2
6	neutral	World Heritage in China	5



The Idea

- The researchers used knowledge based on the field of affective neuroscience, which involves the study of neural patterns associated with emotions
- Studies have shown that specific brain structures, such as those of the limbic system, are linked to a human's emotional state



Feature Extraction

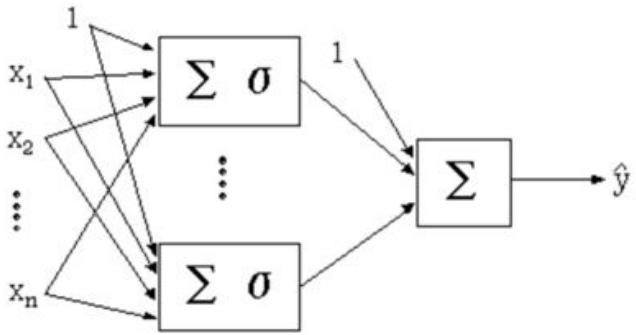
- 5 Brainwaves: Alpha, Beta, Delta, Theta, Gamma
- Brainwaves were used to determine features that would be useful for emotion recognition
- 6 Features that were analyzed:
  - Power spectral density (PSD)
  - Differential entropy (DE)
  - Differential asymmetry (DASM)
  - Rational asymmetry (RASM)
  - Asymmetry (ASM)
  - Differential caudality (DCAU)

Emotion Recognition

- Supervised learning is a machine-learning technique that uses pre-labelled data to train an algorithm
- The researchers built used software that attempts to “learn” in similar ways as humans
- Emotion recognition was done through the use of a feedforward neural network

Neural Networks

- A neural network typically transmits data through layers of “neurons”
- At each neuron, a weighted summation is performed on incoming data, and an activation function (typically a sigmoid function) is applied
- A final weighted summation is performed at the output neuron to produce a result



$$\sigma\left(\sum_{j=1}^{n} w_j x_j + b_j\right)$$

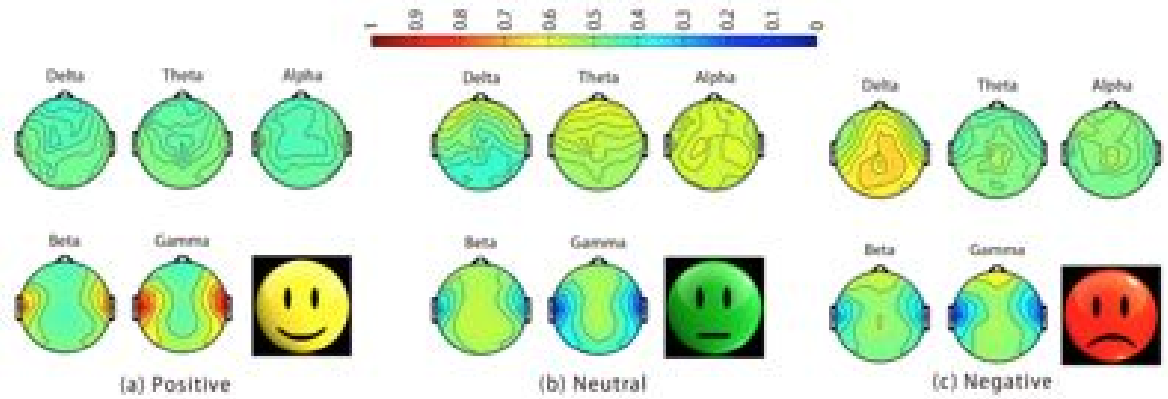
$$\text{Sigmoid}[x] = \frac{1}{1 + e^{-x}}$$

Neural Networks (Cont.)

- At first, the neural network may give seemingly random results
- The network must be trained by comparing results to desired outputs
- By adjusting the weight matrix, the weighted sums at each neuron are also adjusted
- After sufficient training, the neural network can give consistently accurate results

Results

- The machine-learning algorithm in this study was able to categorize emotions with approximately 80% accuracy
- The team plans to further train the algorithm to gauge emotions in individuals of different ages and genders



Worldwide Applications

- Trained algorithms have been shown to solve problems and analyze patterns much more efficiently than most humans
- Machine-learning has profound impacts on the study of topics such as:
  - Human behavior
  - Medicine
  - System security
  - Economic analysis

- The continued development of machine-learning techniques will allow for quicker analysis and resolution of complex problems in the world

References

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