ThoughtViz: Visualizing Human Thoughts Using Generative Adversarial Network

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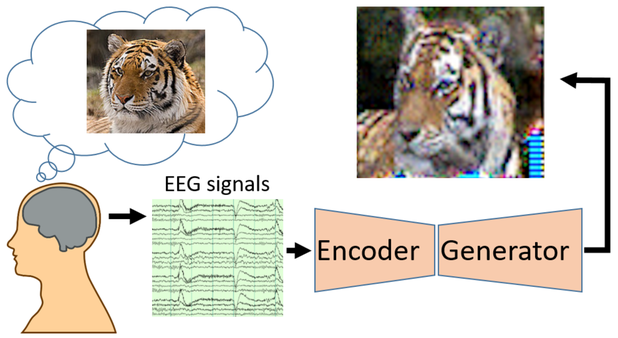
Aim

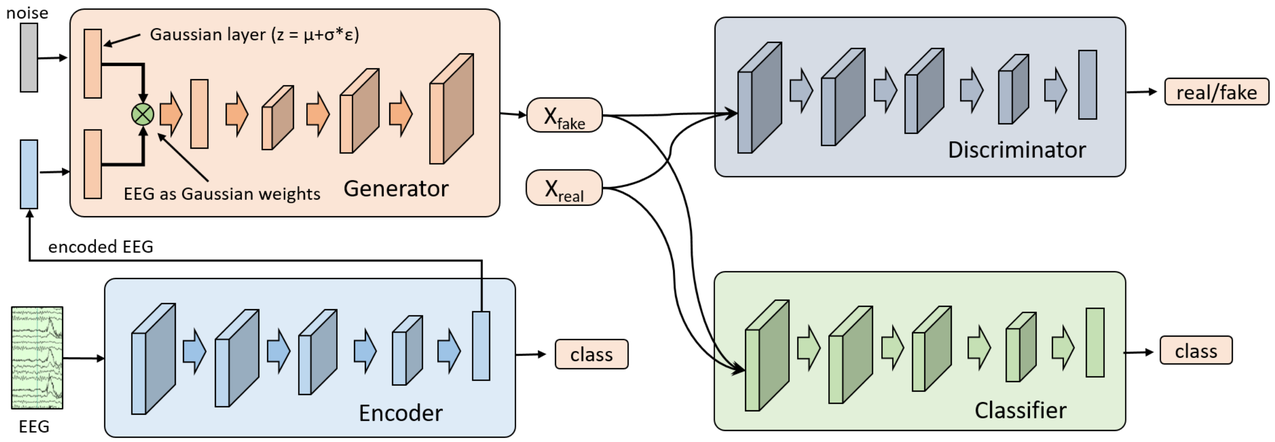
- Generate an image of an object from a thought using EEG recordings.
- Encode EEG signals and use them as conditioning to the generative model.
- Generative Adversarial Networks are used to generate images.



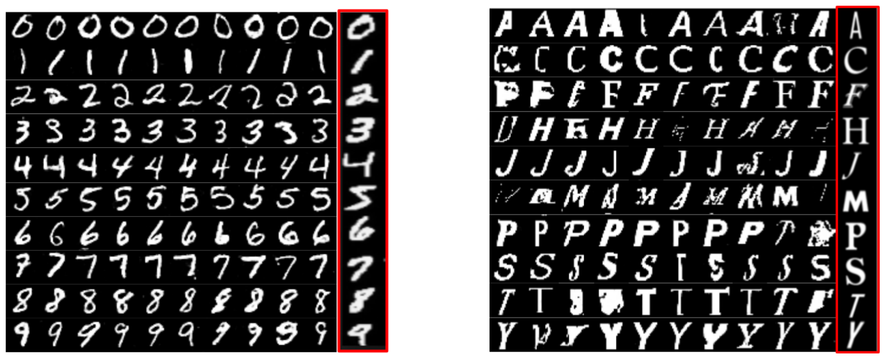
Architecture

Objective Function

$$\max_D \min_G \min_C V_D(D,G,C) = \max_D \min_G \min_C \left(E_{x\sim p_{data}}[logD(x)] + E_{z\sim p_z}[log(1-D(G(z)))] + E_{z\sim p_z}[log(C(G(z)))] \right)$$

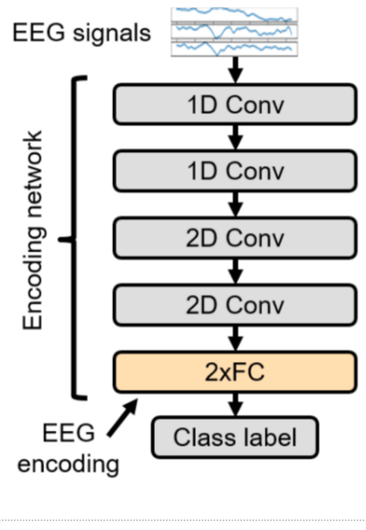


Generated Images



Approach

Phase 1 : EEG Encoding



Phase 2 : Image Generation

	Digits	Characters	Objects
Dataset	MNIST	Chars74K	ImageNet

EEG Conditioning

$$w = eeg * (\mu_i + \sigma_i \epsilon) \quad \text{where} \quad \epsilon \sim \mathcal{N}(0,1)$$

- Trainable Gaussian layer in Generator using EEG encoding as weights .

Results

EEG Classification

	Digits	Characters	Objects
Accuracy	72.88%	71.18%	72.95%

Image Classification

	Digits	Characters	Objects
AC-GAN [21] (EEG Conditioning)	74.10%	52.57%	70.36%
AC-GAN [21] (1-hot Conditioning)	82.06%	79.95%	62.44%
Brain2Image [14]	28.32%	17.76%	12.05%
Our approach	**99.27%**	**92.23%**	**97.12%**

Inception Score

Method	Inception Score
AC-GAN [21]	4.93
AC-GAN [21] (1-hot)	3.10
Our Approach	**5.43**

Object Class	Mean	Standard Deviation
Apple (n07739125)	5.477	0.065
Car (n02958343)	5.445	0.072
Dog (n02084071)	5.463	0.073
Gold (n03445326)	5.484	0.096
Mobile (n02992529)	5.511	0.068
Rose (n12620196)	5.470	0.088
Scooter(n03791053)	5.485	0.072
Tiger (n02129604)	5.502	0.035
Wallet(n04548362)	5.439	0.067
Watch (n04555897)	5.448	0.046
All	5.439	0.064

References

[14] Isaak Kavasidis, Simone Palazzo, Concetto Spampinato, Daniela Giordano, and Mubarak Shah. 2017. Brain2Image: Converting Brain Signals into Images. In *Proceedings of the 2017 ACM on Multimedia Conference*. ACM, 1809–1817.

[21] Augustus Odena, Christopher Olah, and Jonathon Shlens. 2017. Conditional image synthesis with auxiliary classifier gans. *ICML* (2017).

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