Project Plan

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1 Introduction and Goals

Electroencephalography (EEG) measures electrical activity at the surface of the brain. These electrical readings at the surface measure activity within the brain as well as from external sources such as eye blinks and electromagnetic fields. Thus, interpreting EEGs is a complex task and prone to error as a physician must first distinguish between internal and external activity before reading the EEG. This tasks seems ripe for the application of machine learning. The goal of this project is to create a model that given an EEG can generate a new EEG without external noise. To accomplish this, a semi supervised adversarialy trained transformational network with recurrent bidirectional long short-term memory (LSTM) cells will be implemented. This machine learning architecture (Figure 1) employs attributes of generative adversarial networks (GANs) and variatonal auto encoders (VAEs) to accomplish this task.

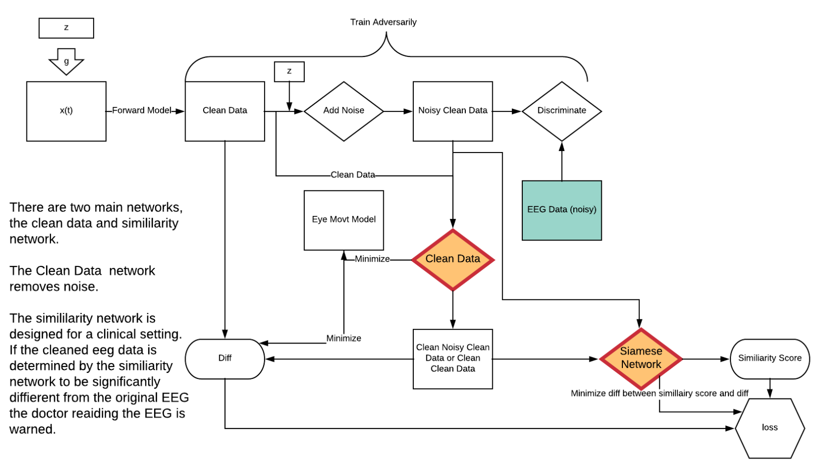

Figure 1: Network Achritecutre

One significant issue that will be faced is that absence of noise free EEG data. To circumvent this issue, established physics models will be incorporated in order to create noise free EEG data. Noise (z) generated by a Gaussian distribution will be processed by a physics model in order to create EEGs without artifacts.

The first model will omit any conditional data such as patient age, weight, and gender. This limitation shall be imposed primarily to set a baseline performance that can be referenced after adding conditional data to the architecture. Secondly, a model built without conditional information can be built faster and more easily. This model will give an indication of how well the devised architecture works and whether modifications are necessary before adding conditional data.

2 Risks and Safety

No risks are anticipated during this project.

3 Updates

A conditional noise vector will be concatenated with clean EEG data before noise is added. This conditional vector will "instruct" the add noise network. After the add noise model has been trained, each parameter of the conditional vector will be individually manipulated in order to isolate individual artifacts.

4 Resources

To be made into bibliographies

- https://arxiv.org/abs/1611.07004
- https://arxiv.org/abs/1701.07875
- https://arxiv.org/abs/1406.2661
- https://arxiv.org/abs/1312.6114
- https://arxiv.org/abs/1611.07004
- https://arxiv.org/abs/1810.08462
- https://www.researchgate.net/publication/285772451