

NeuroTech: AI Assistant for Schizophrenia Diagnosis

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Introduction

About 1 in 5 adults in the US live with a mental illness, 57.8 million people in 2021. Schizophrenia affects approximately 24 million people worldwide, however only 1 in 3 diagnosed with Schizophrenia receive specialist mental health care, partially due to the fact that certain parts of the world have limited mental health services. Automation of Schizophrenia diagnosis has been studied, not implemented due to ethical constraints. However, Research has produced Machine learning algorithms that show high accuracy for diagnosis.

Novelty

NeuroTech performs Schizophrenia diagnosis using a Convolutional Neural Network (CNN) classifier for analysis of brain MRI scans, and Natural Language Processing (NLP) for analysis of medical records. While other research has produced algorithms for Schizophrenia diagnosis using CNNs before, NeuroTech is novel in that it combines NLP with CNN analysis. Schizophrenia shows patterns among different genders and age groups, NeuroTech takes this into account with the NLP analysis.

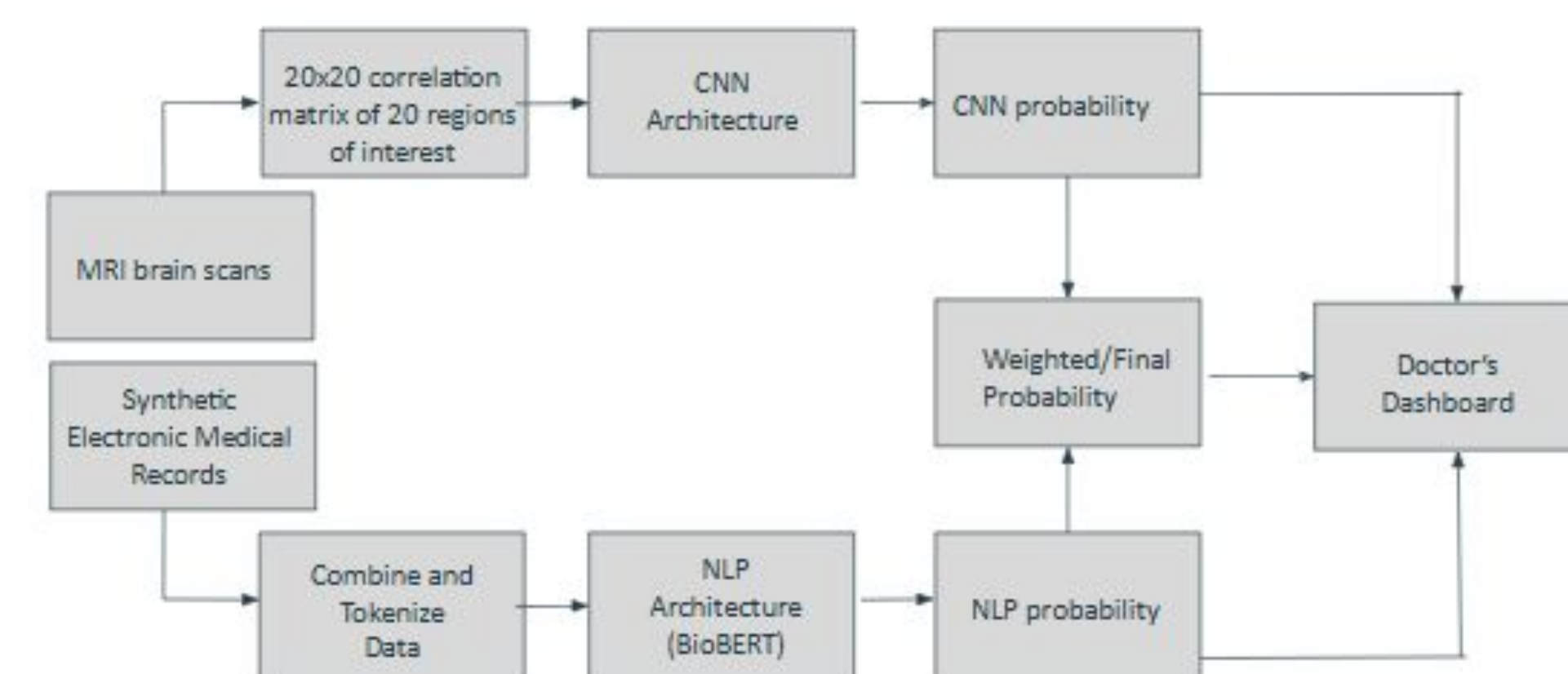


Fig. 1: Systems Architecture

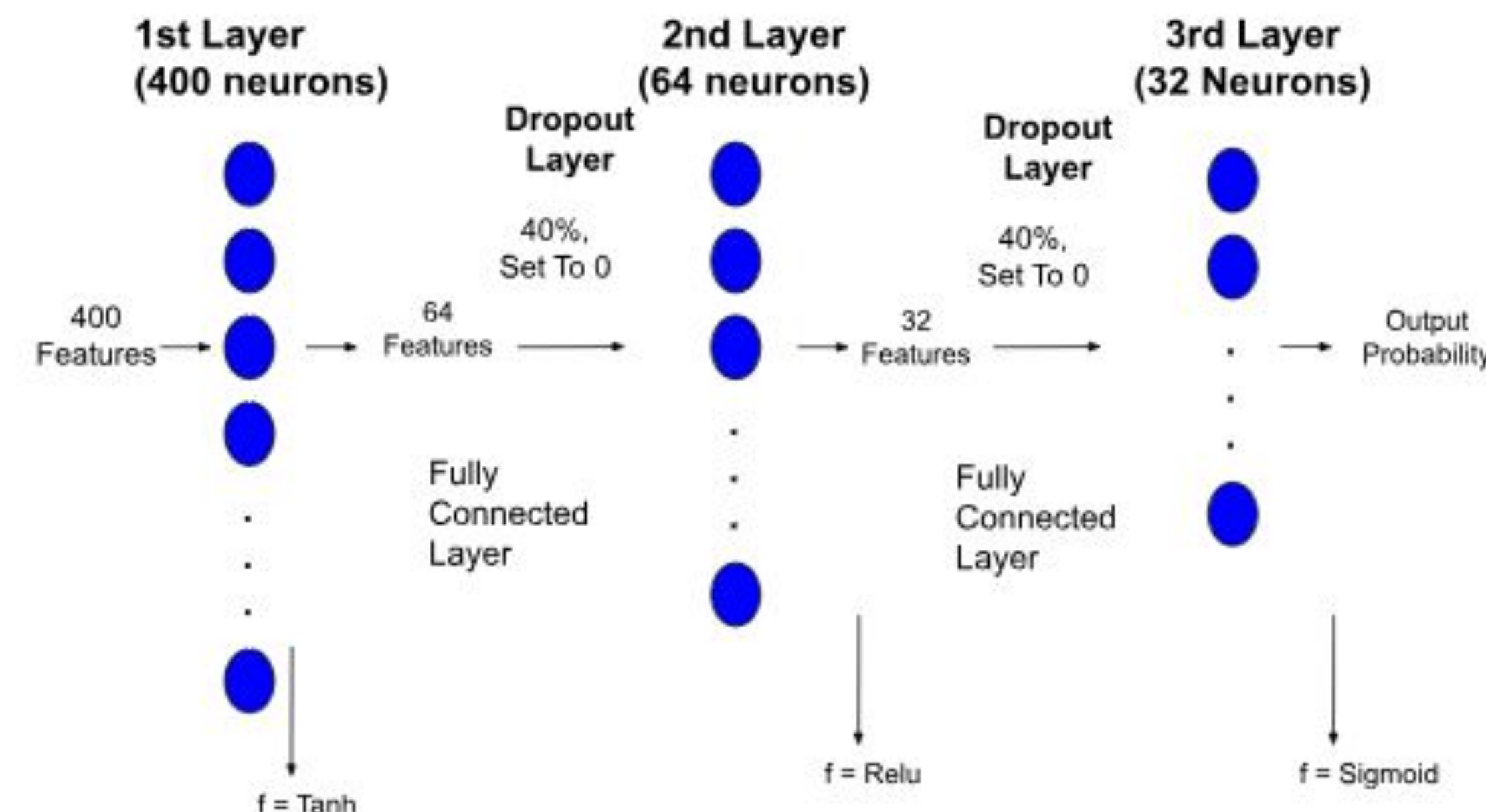


Fig. 2: CNN Architecture

Methods

As shown in Fig. 1, NeuroTech uses two architectures for diagnosis: the CNN and NLP. The CNN architecture processes a 20x20 correlation matrix of 20 regions of interest within fMRI imaging results from COBRE (Fig. 2). The NLP architecture utilizes BioBERT, a deep learning algorithm that is pre-trained on billions of words from biomedical domain corpora (Fig 3). This algorithm then processes synthetic data with the patient's age, gender, doctor's notes, and family notes. The final probability is made from a weighted average of the CNN and NLP probability outputs.

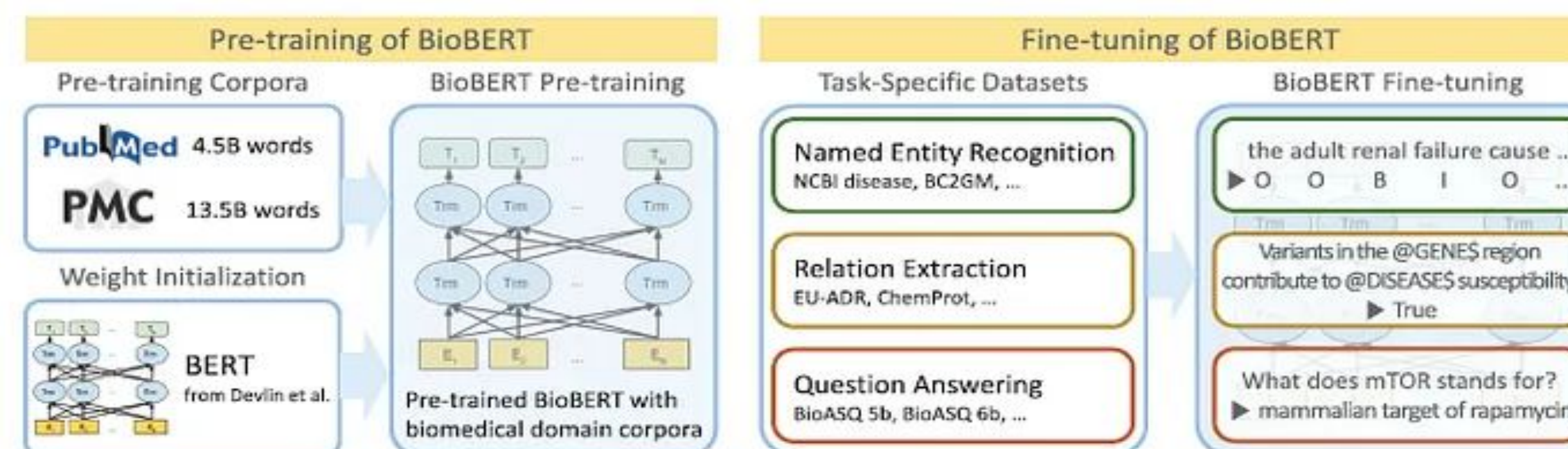


Fig. 3: NLP Architecture (BioBERT)

Results

NeuroTech produces a probability of Schizophrenia to assist the Doctor's evaluation of the patient. The CNN architecture had a ~90.3% accuracy for diagnosis over 100 test images, and the NLP architecture had a ~97.9% accuracy for diagnosis over 100 patients. The CNN architecture output is shown in Fig. 4.

Accuracy: 0.9032258064516129
Correct HC: 15
Correct SZ: 13
False HC: 1
False SZ: 2

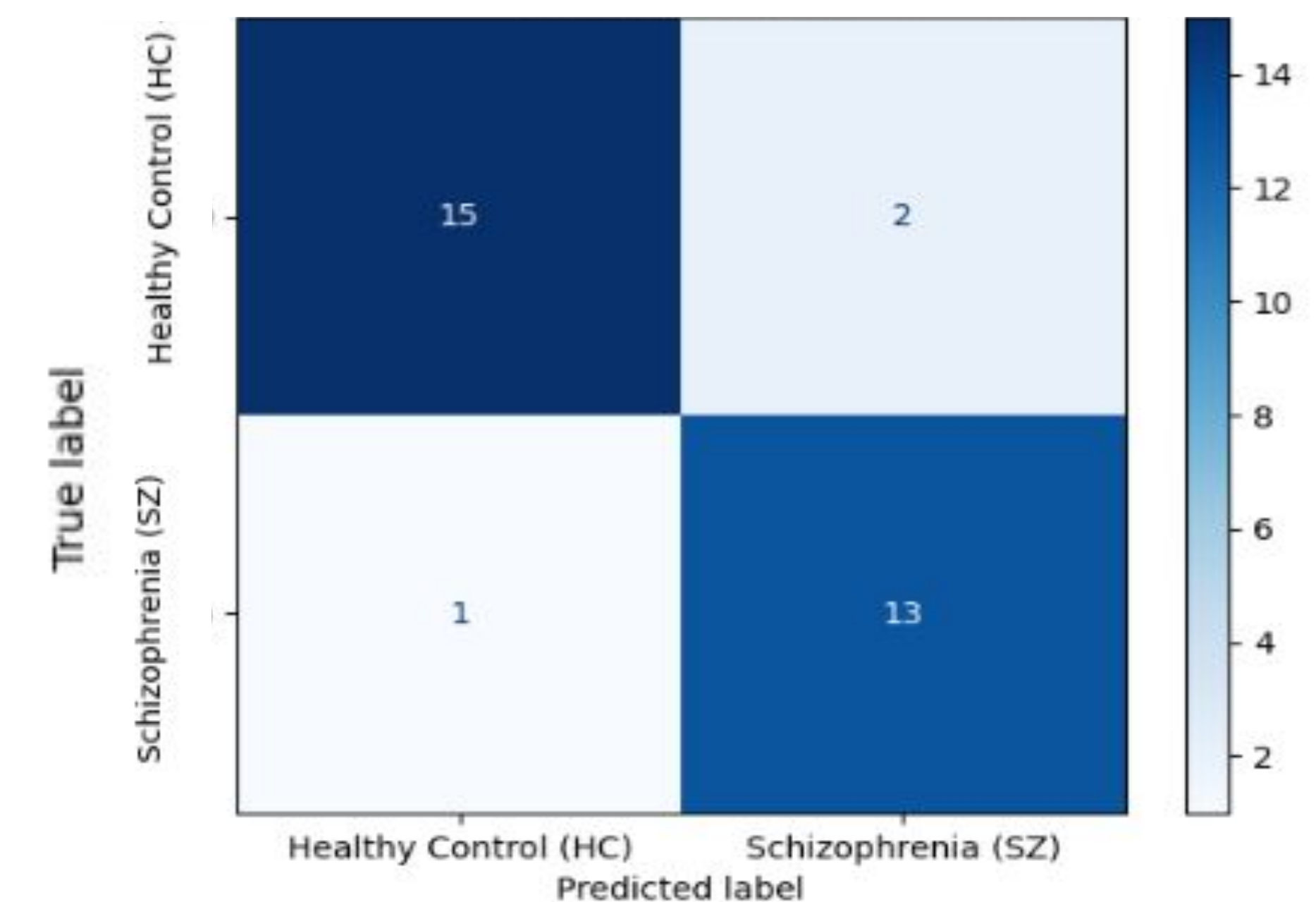


Fig. 4: CNN accuracy + Confusion Matrix

Impact & Future Work

This project achieved the creation of a tool for diagnosis based on a diverse data set, that allows for Doctor interpretation of probabilities rather than just a "positive/negative" binary output. NeuroTech can yield Early Detection for Onset Schizophrenia, and a higher confidence in a physician's final diagnosis, reducing the long-term impact of the illness on the patient. Additionally, this tool can be provided at a cheap price in regions of the world where there may be a shortage of healthcare professionals. In the future, with a dataset directly from a hospital rather than synthetic data, NeuroTech will only increase in its reliability.