Executive Summary

The Dementia Voice Analyzer project, inspired by the 2021 Address Challenge, aims to revolutionize Alzheimer's Disease (AD) detection through speech pattern analysis. With the projected rise in the number of Americans living with AD to 13.8 million by 2050, the need for scalable and cost-effective diagnostic methods is critical. Current diagnostic approaches for AD are laborious and expensive, highlighting the urgency for a more accessible and efficient solution through machine learning.

The primary objective of the project is to enable early detection of AD, essential for timely intervention and management. We utilized data from Dementia Bank, a repository of multimedia interactions focused on studying communication in dementia. The dataset consists of 237 recordings where participants described the cookie theft picture. This dataset includes 122 subjects diagnosed with Alzheimer's and 115 subjects from a control group.

Data processing involved using openSMILE v2.5.0 in Python to extract features from audio files, focusing on eGeMAPS features related to frequency, amplitude, and spectral data. Feature reduction techniques were employed to address highly correlated features, resulting in a reduced feature set from 88 to 37. Baseline models such as Logistic Regression, k-NN, and SVM were initially explored, achieving modest accuracies ranging from 60% to 65%.

The project's neural network models included simple feedforward Neural Networks and Long Short-Term Memory (LSTM) networks. The feedforward Neural Network model demonstrated promising results with an accuracy of 68%, precision of 69%, and recall of 72% while the LSTM model exhibited a slightly lower accuracy of 60%, precision of 58%, and notably higher recall of 86%.

In conclusion, the project's approach leveraging machine learning and speech analysis holds significant potential to advance AD diagnosis and management, thereby enhancing the lives of affected individuals and families, while facilitating the work of healthcare professionals. Moving forward, the next steps include incorporating linguistic features, refining neural network architectures, and developing a web application. Furthermore, the project's framework could be extended to applications beyond AD detection, such as concussion detection, showcasing its broader impact and significance in healthcare innovation.