Dementia Voice Analyzer

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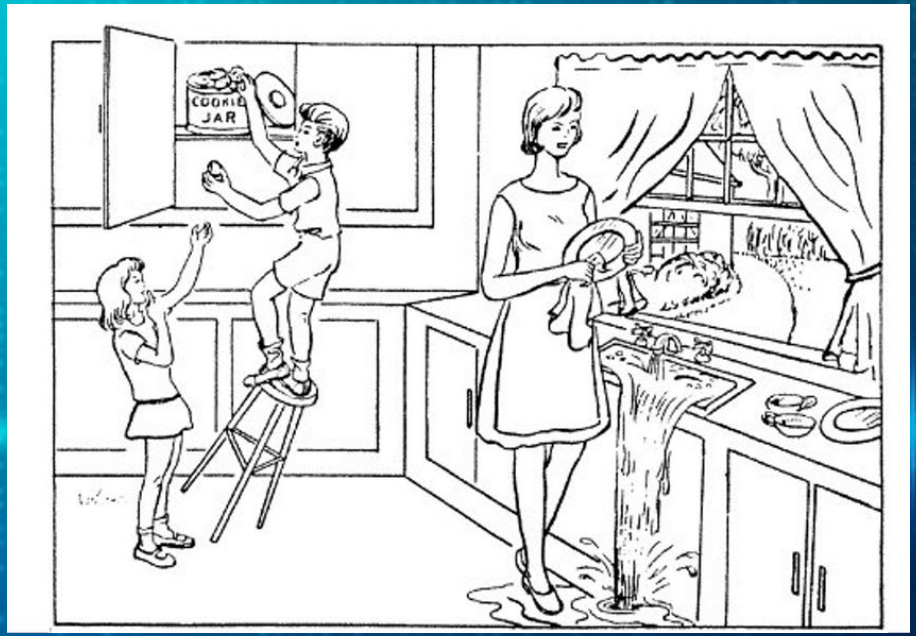
Introduction

- Project inspired by the 2021 Address Challenge, aiming to revolutionize Alzheimer's Disease (AD) detection via speech pattern analysis.
- Number of Americans living with AD projected to rise from 6.2 million to 13.8 million by 2050, demanding scalable and cost-effective diagnostic methods.
- Current AD diagnostics are arduous and costly; our solution offers a more accessible and efficient approach through machine learning.

The goal

- Early detection crucial for timely intervention and management, overcoming current diagnostic challenges.
- We want to develop and validate a machine learning-based method for early AD detection through speech analysis.
- Goal: Provide healthcare professionals with a cost-effective, scalable, and accurate tool for early AD detection.

Data Sources



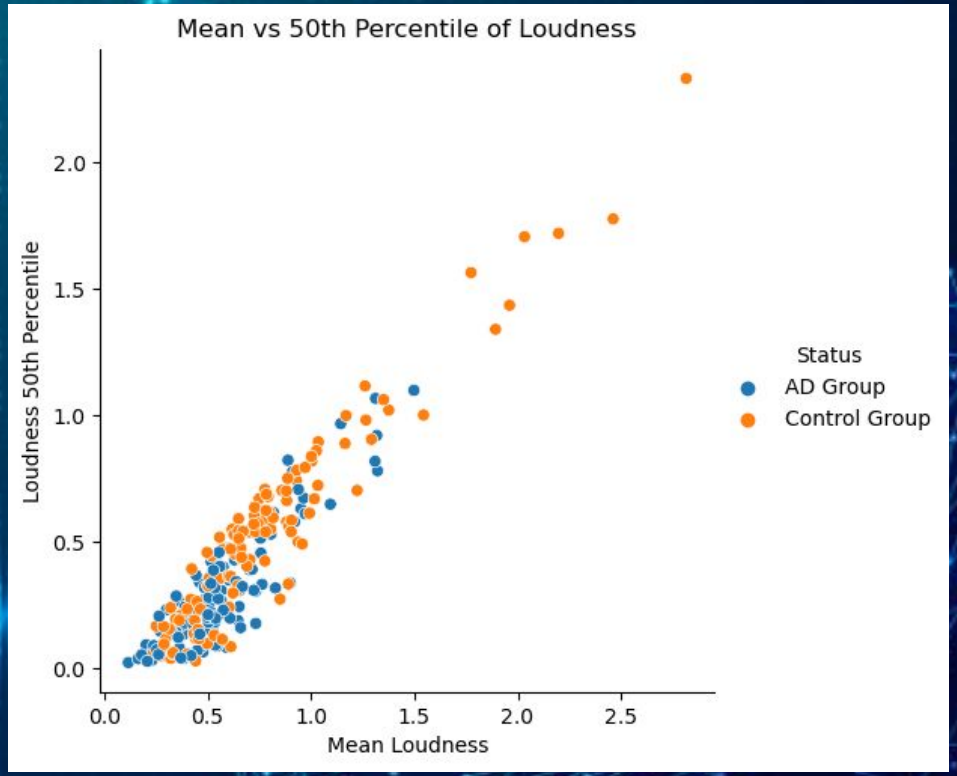
- Data was obtained through Dementia Bank - a shared database of multimedia interactions for the study of communication in dementia
- The dataset consist of 237 recordings of participants describing the cookie theft picture
- 122 subjects have Alzheimer's diagnosis, 115 subjects from control group

Data Processing

- We used openSMILE v2.5.0 in Python to process audio files and extract features
- We use the eGeMAPS features as input of our models
- eGeMAPS is a standardized and minimalistic set of acoustic parameters related to frequency, amplitude and spectral data
- Statistic data: 88 features per recording
- Sequential data: time series for 25 features

Feature reduction

1. Among the 88 statistic features several were highly correlated
2. Feature selection reduced the feature set from 88 to 37
3. PCA was not successful to reduce to low-dimensional problem



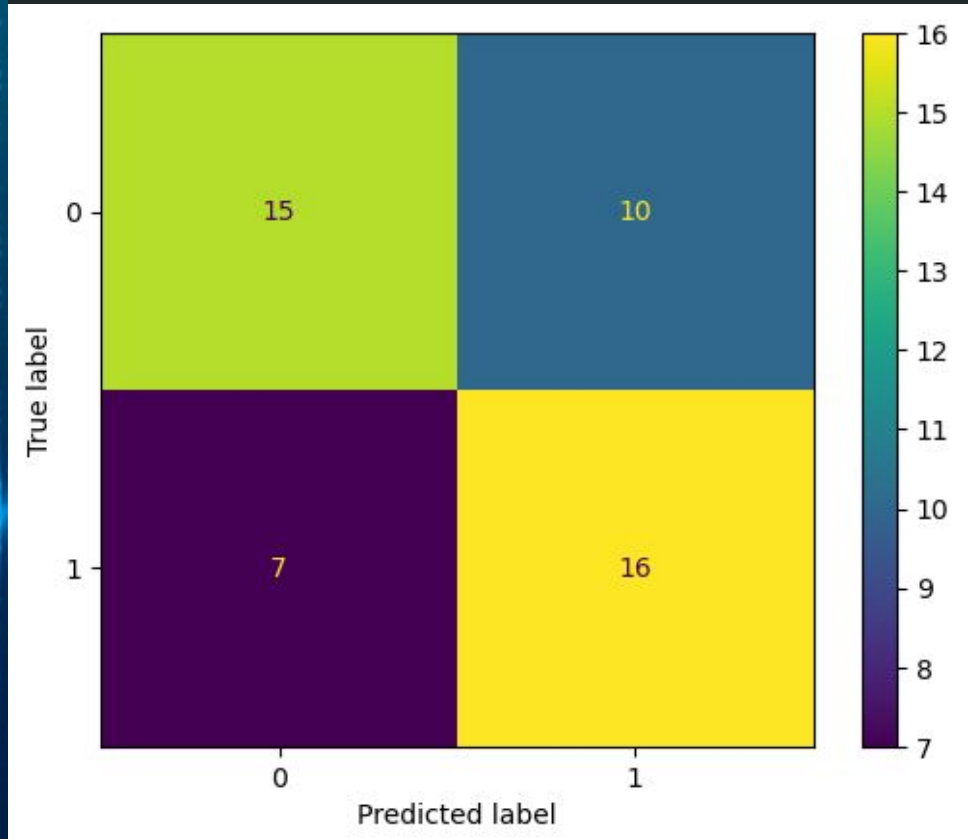
Modeling

1. Baseline Models
    - Logistic Regression
    - k-NN
    - SVM
2. Neural Network
3. Recurrent Neural Network

Logistic Regression

- Accuracy - 65%
- Precision - 68%
- Recall - 60%

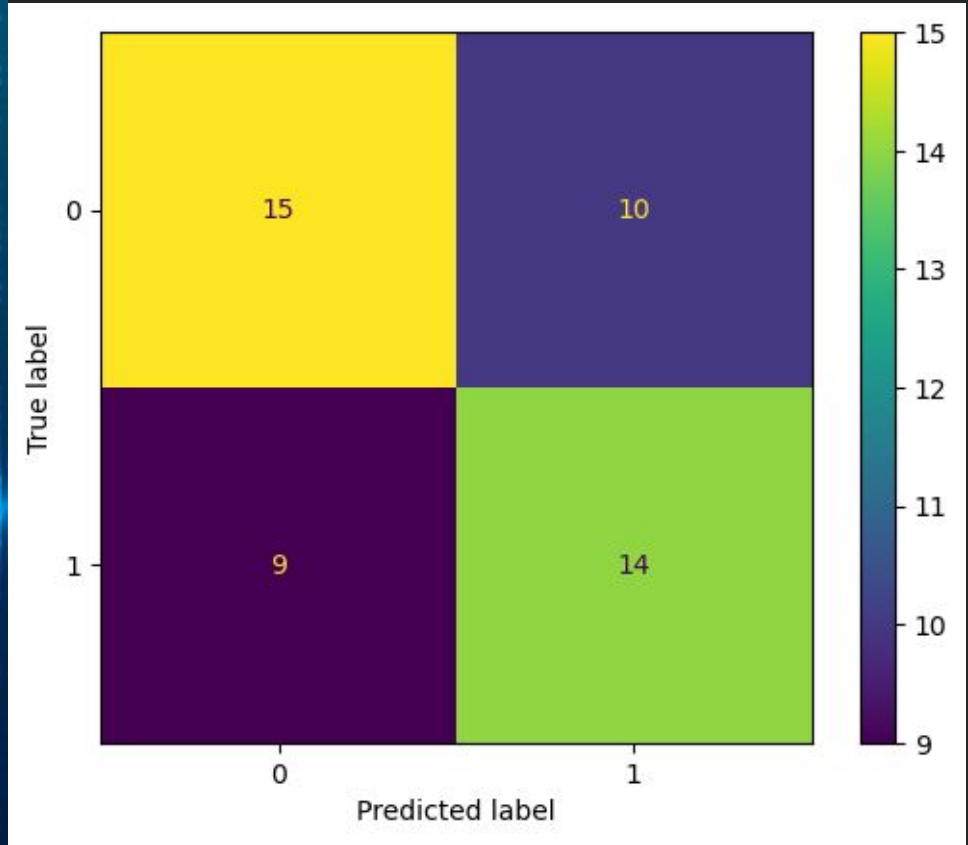
Confusion Matrix



k-NN

- Accuracy - 60%
- Precision - 62%
- Recall - 60%

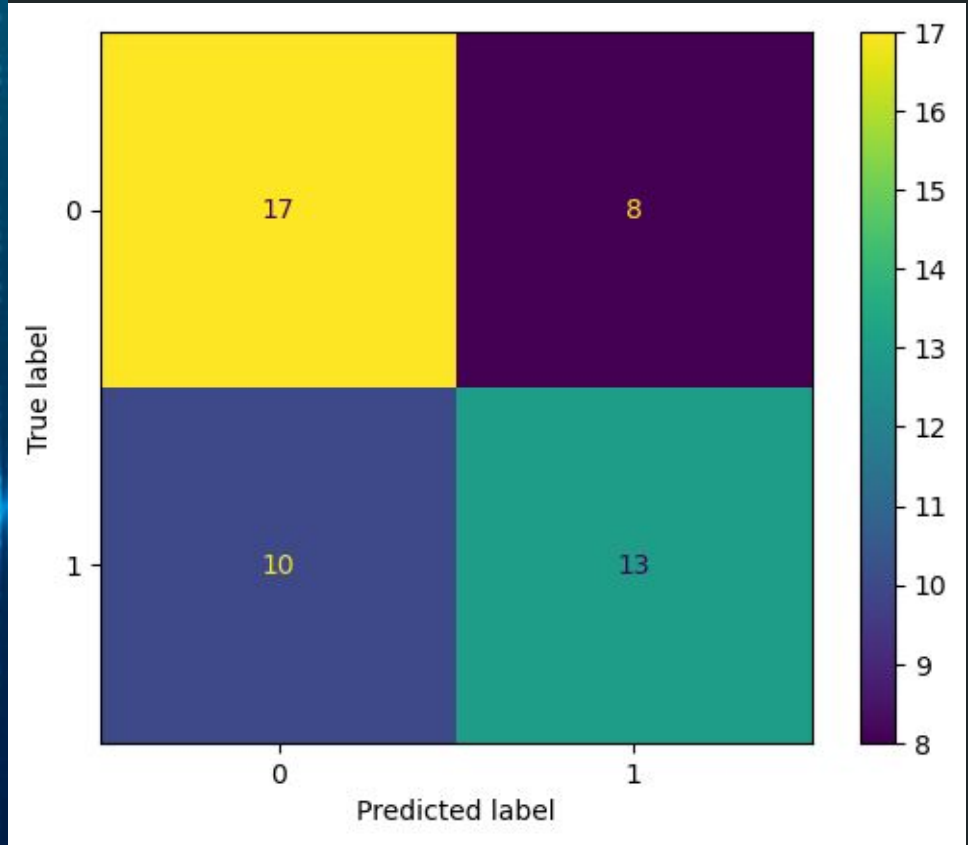
Confusion Matrix



SVM

- Accuracy - 62%
- Precision - 63%
- Recall - 68%

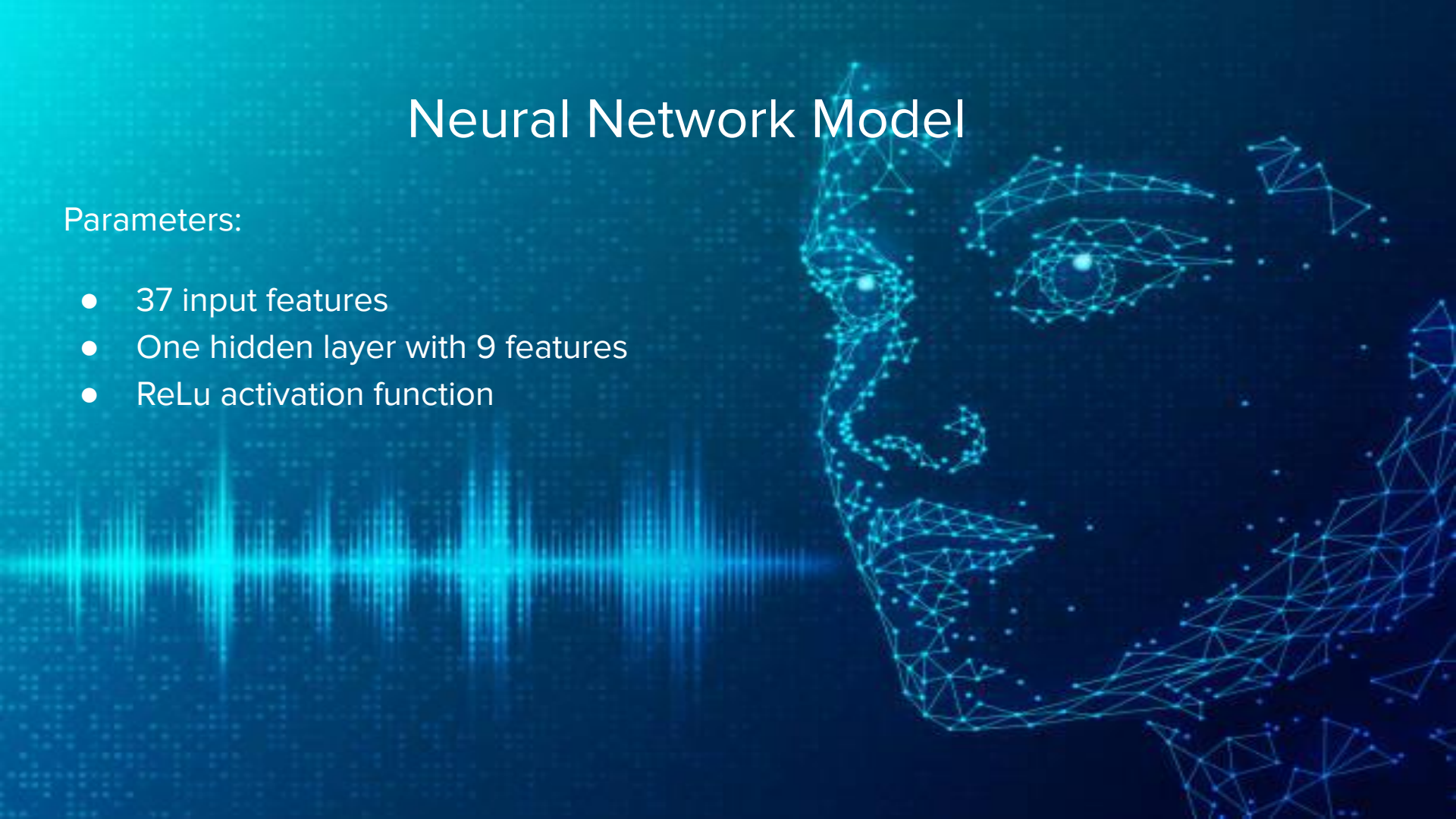
Confusion Matrix



Neural Network Model

Parameters:

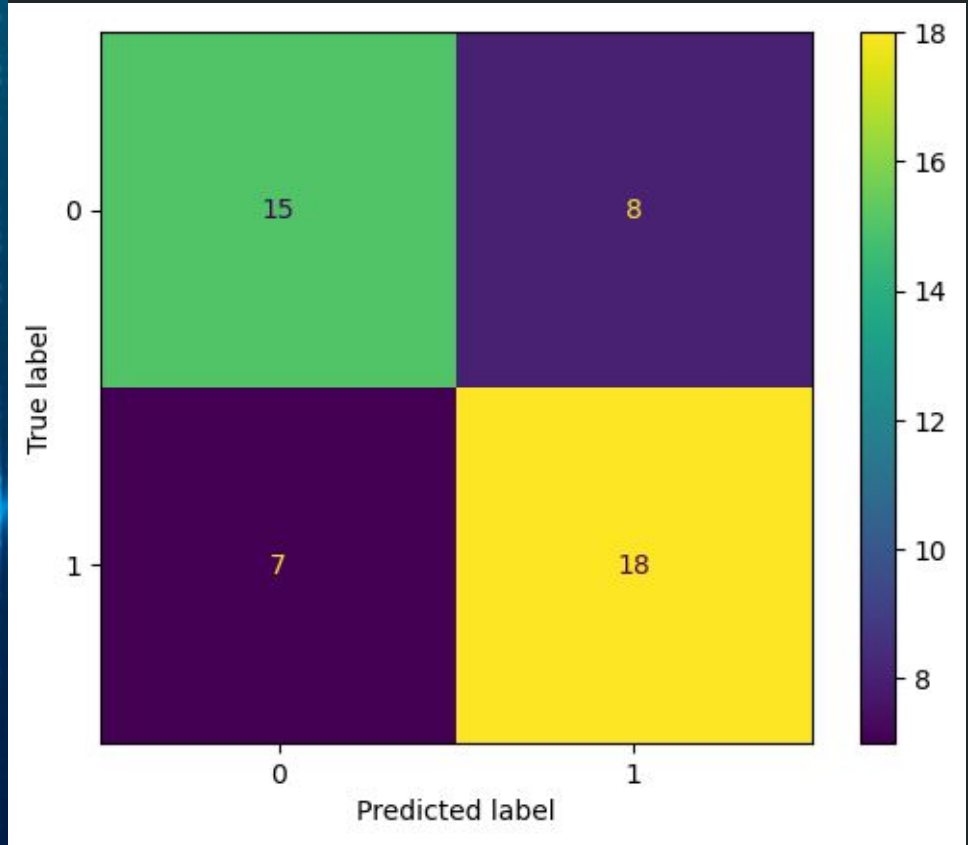
- 37 input features
- One hidden layer with 9 features
- ReLu activation function



NN

- Accuracy - 68%
- Precision - 69%
- Recall - 72%

Confusion Matrix



RNN-LSTM Model

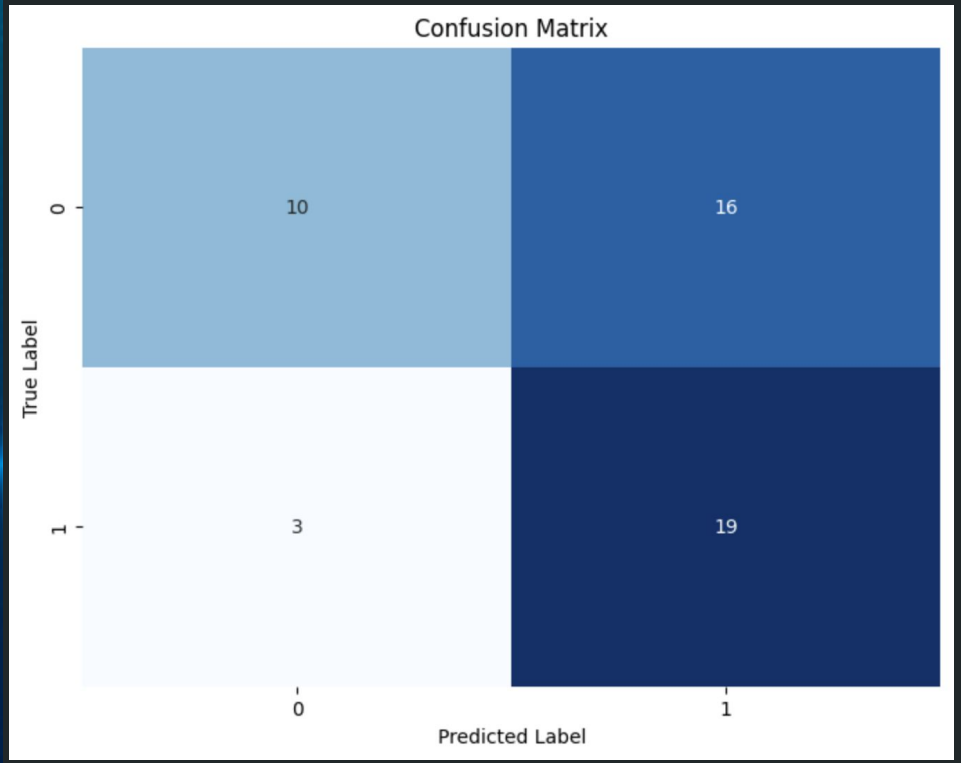
Parameters:

- Input Size: 25
- Hidden Layer Size: 128
- Number of Hidden Layers: 2
- Dropout Probability: 0.5

RNN-LSTM

- Accuracy - 0.60%
- Precision - 0.58%
- Recall - 0.86%

Confusion Matrix



Conclusion

Approach: Using machine learning and speech analysis has potential to advance Alzheimer's Disease diagnosis and management.

Impact: Enhance the lives of affected individuals and families, and facilitate work of healthcare professionals.

Significance: Promising step forward in Alzheimer's Disease care.

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Future Work:

1. Use linguistic features
2. Use RNN and CNN
3. Develop a web app
4. The idea could be used for concussion detection