Automated COVID-19 Detection Using Deep Learning

Rodrigo Alarcon, Emma Conti, Lamine Deen,
Audrey Eley
Advisor: Dr. Zahra Nematzadeh

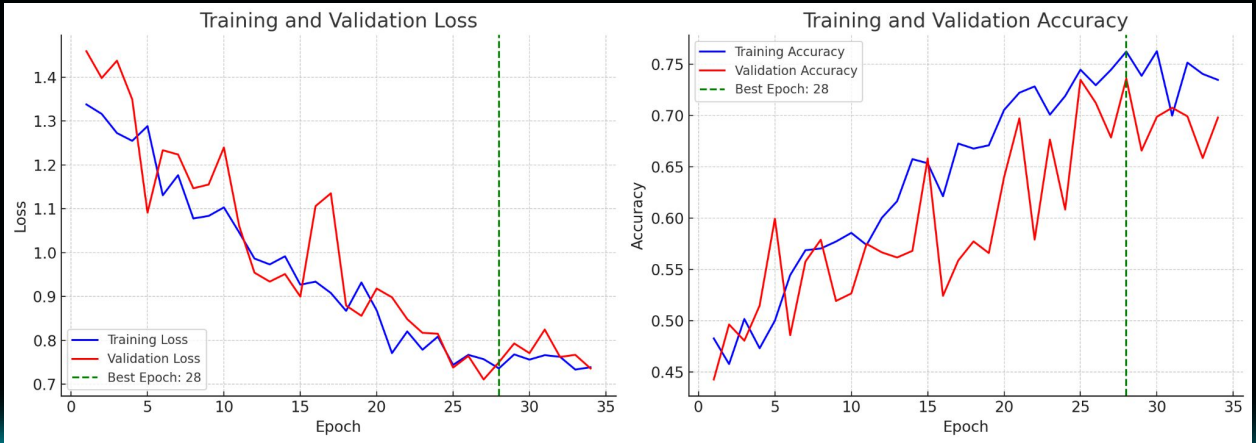
Task Matrix: Milestone 6

Task	Rodrigo	Emma	Lamine	Audrey
2. ML testing and refinement of framework	0%	25%	50%	25%
3. Web testing	40%	20%	20%	20%
4. Integrating Base ML Model with Web Using a Neural Network Framework	50%	0%	0%	50%
Task	Rodrigo	Emma	Lamine	Audrey

Task 1 - ML Improvements

Final version of CNN: Attention Enhanced CNN

Final Precision: 69%, Accuracy 70%



Task 1 - ML Improvements

Data preprocessing steps:

1. Initial Data Audit
2. Filtering & Cleaning
3. Waveform to Mel-Spectrogram
4. Cough Segment Extraction
5. Metadata Sync & Class Selection
6. Oversampling Minority Class
7. Augmentation Integration
8. Final Balancing & Shuffle
9. Dataset Splitting
10. PyTorch DataLoader Prep

Hyperparameters for the mel-spectrogram

Target Sample Rate: 22050
Length of the FFT window: 2048
Hop length for STFT: 256
Number of mel bands: 256
Maximum frequency to display: 8000

Model results:

Training Accuracy: 76.48%
Validation Accuracy: 69.82%
Best Epoch: 28
Training Runtime: 45.5 minutes

Task 1 - ML Improvements

Model Overview Architecture:

- Block 1: Conv 3×3 (1→32) → BN → ReLU → MaxPool 2×2 → Channel-Attention 32 → Spatial-Attention
- Block 2: Conv 3×3 (32→64) → BN → ReLU → MaxPool 2×2 → Channel-Attention 64 → Spatial-Attention
- Block 3: Conv 3×3 (64→128) → BN → ReLU → MaxPool 2×2 → Channel-Attention 128 → Spatial-Attention
- Head: AdaptiveAvgPool 1×1 → Flatten → FC 128→64 → ReLU → Dropout 0.5 → FC 64→2 (logits)

Task 2 - Web Testing

WebApp Testing

- User experience survey sent out
- Implementing the model
- Updating the Research Page

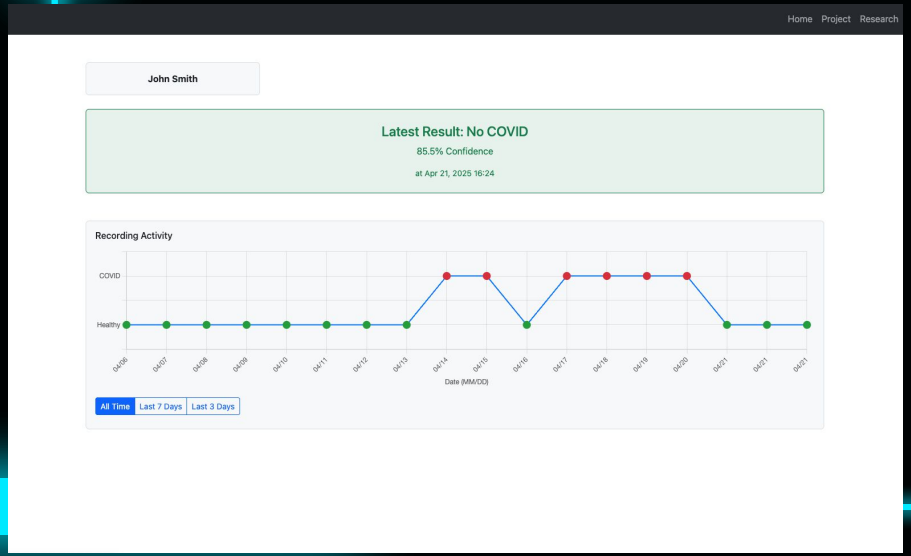
WebApp Improvements

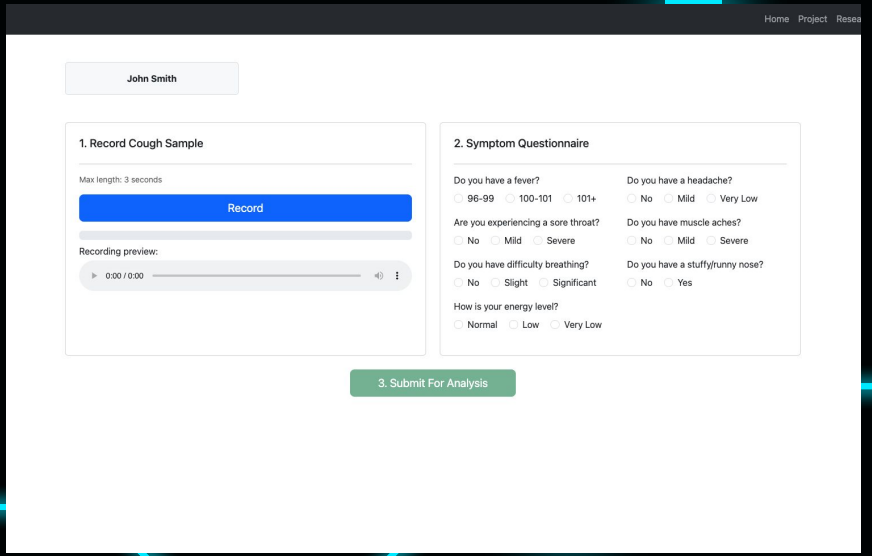
- Changed page
- Changed features of graphs
- Added additional symptoms to questionnaire

Task 3 - ML/Web Integration

Web Integration

- Implemented Attention Enhanced CNN model





Lessons Learned

Lessons Learned

- If the accuracy of the labeled data had been checked sooner, the early CNN and ResNet50 development would have gone better
  - Would have been able to tell if the results we initially received were accurate
- Certain accommodations must be made on the website to account for the fact that our primary user will be sick or impaired
  - Adjusting times and ways to view the features for ease of use rather than providing the maximum amount of information at a time
- Ensuring the security of the data
  - Making sure the database implemented to save each recording was secure because it contains medical information was harder to achieve than initially thought

Showcase Poster

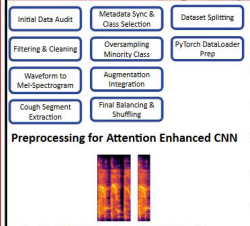
NORTHROP GRUMMAN
ENGINEERING & SCIENCE
STUDENT DESIGN SHOWCASE
FLORIDA TECH

Automated COVID-19 Detection

Rodrigo Alarcon, Emma Conti, Lamine Deen, Audrey Eley
Faculty Advisor: Dr. Nematzadeh, Dept. of Computer Science, Florida Institute of Technology

vocovid

PHASE 1: Data Cleaning & Preprocessing



Preprocessing for Attention Enhanced CNN

Audio 242 & Shortened Mel-Spectrogram

- Used Kaggle dataset: "Covid-19 Cough Audio Classification"
- All recordings converted into Mel Spectrograms
- Binarized target variable to "Healthy" and "COVID"

CNN Model Achritechture

- Block 1: Conv 3×3 (1→32) → BN → ReLU → MaxPool 2×2 → Channel-Attention 32 → Spatial-Attention
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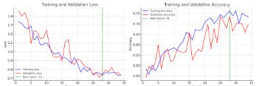
PHASE 2: Classification & Prediction

ResNet50 | Attention Enhanced CNN

Developed Models for Testing



Attention Enhanced CNN Training Validation Loss and Accuracy

- ResNet50 model uses pretrained ResNet50 model and replaces with our data at the last layer to maximize accuracy
- Attention Enhanced CNN uses 3 convolutional blocks
- 1,118 datapoints are used under each classification using oversampling to ensure there is an equal amount of each evaluation type
- Attention Enhanced CNN was selected for integration within the web application

PHASE 3: Evaluation

Healthy

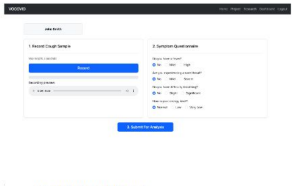
COVID-19

Binary Evaluation of User Status

- Highest achieved accuracy with Attention Enhanced CNN was 69%
- Precision was 73%, minimizing false positive and negatives
- uses a binary model to determine if user has COVID or is considered healthy
- results may indicate the user is 'symptomatic' under a healthy evaluation based on confidence level

PHASE 4: Web Application

- Interface for classification via CNN model
- Displays all research done for the project on the various types of ML models
- Integrates the CNN and allows users to upload recordings of coughs
- Symptom questionnaire
- Login and recording saved securely
- Can save multiple recordings per user
- Segments recording to one cough, converts to Mel spectrogram, and classifies recording
- Recommends testing for COVID-19 if classification of recording is COVID-19 positive



VoCOVID Dashboard

VoCOVID Recording Activity

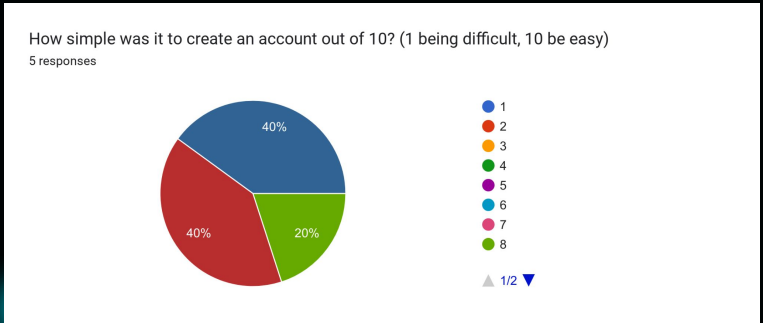
User Testing

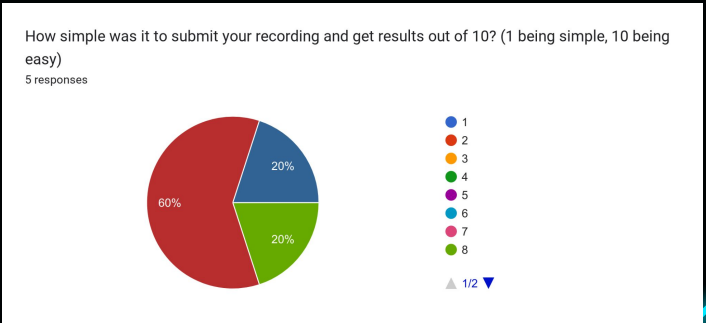
Users rated it as extremely easy to use

Average Ease of Use for Creating an Account: 7.6 our 10 (10 being easy)

Average Ease of Use for Recording and Receiving an Evaluation: 9.5 (10 being easy)

Only 1 user did not receive the results they were anticipating to receive (Healthy, COVID)





User Manual

Table of Contents

Thank You to Our Testers

College Students
Erin Brasher
Persea Halloran
Charlotte Eley
Christopher DeMuro
Giulianna Hartsell

Over 40 Age Group
Christine Conti
Eley

Under 18 Age Group
Daisy Carter
Nicholas Carter

18-39 Age Group
Christopher Spillane

Demo

Questions?