IMPLEMENTATION OF CONVOLUTIONAL NEURAL NETWORK APPROACH FOR COVID-19 DISEASE DETECTION

HUAN LI
FABIO PECORA
ABAYOMI SHOSILVA

Abstract

Two CNNs

- **Binary classification**
  (Detects the presence)
- **Multiclass classification**
  (COVID-10 vs pneumonia vs normal cases)

Accuracy

- **Model 1 (binary)**
  98.92% accuracy
- **Model 2 (Multiclass)**
  98.27% accuracy

Highlights

- Most extensive clinical dataset (4,575 images)
- Hyperparameter Optimized with Grid Search
- No manual Extraction of Diseased Areas

Introduction

COVID 19 OVERVIEW

- Identified in December 2019, Wuhan, China
- Highly contagious, global health crisis
- Typical diagnosis: swabs (time consuming, sampling errors)

NEED FOR INNOVATION

- Computer-Assisted Diagnostic systems enhance diagnostic speed and accuracy
- Chest X-rays present potential for early detection of COVID-19

OBJECTIVE OF STUDY

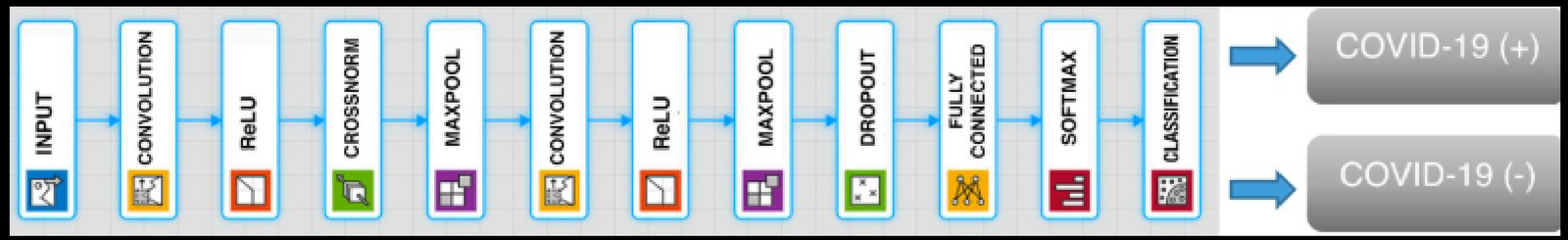
- To leverage Convolutional Neural Networks (CNNs) for efficient and automated diagnosis using X-ray images

Methodology

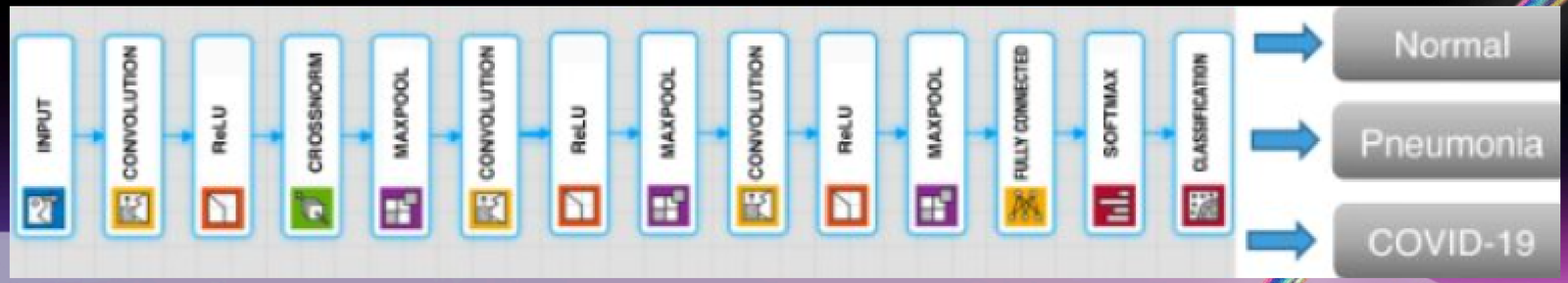
Dataset used: 4,575 chest X-ray images:
-1,524 COVID-19 images
-1,527 pneumonia images
-1,524 normal images

Two CNN architectures designed for:

- Task 1: Binary Classification (positive vs. negative) with 12 weighted layers



- Task 2: Multiclass classification (Normal, Pneumonia, COVID-19) with 14 weighted layers



Technical Approach & Experimental Setup

Task 1

- Input 227x227 pixel images
- 12 Layers: Convolutional layers, ReLU, Max-Pooling, Fully Connected layer, Softmax
- Hyperparameters optimized using Grid Search

Task 2

- Input 227x227 pixel images
- 14 Layers: Convolutional layers, ReLU, Max-Pooling, Fully Connected layer, Softmax
- Grid Search for hyperparameter tuning

Optimizer: Stochastic Gradient Descent with Momentum (SGDM)

Training Process: TMultiple iterations with validation for overfitting prevention

Result and Performances

TASK 1: (BINARY CLASSIFICATION)

Accuracy: 98.92%
Area Under Curve (AUC): 0.9957.

TASK 2: (MULTICLASS CLASSIFICATION)

Accuracy: 98.27%
Demostrated effectiveness for large clinical dataset

THE STUDY OUTPERFORMED EXISTING STATE-OF-THE-ART METHODS

Togacar et al.: 99.27% accuracy (small dataset).
Ozturk et al.: 87.02% for multiclass classification.

This study utilized the largest dataset and achieved state-of-the-art performance.

Conclusion

Two novel CNN models successfully detect and classify COVID-19 from chest X-rays.

High accuracy and robustness achieved for binary and multiclass tasks. Providing a rapid, accurate alternative to traditional methods.

Demonstrates potential for broader medical imaging applications.

STUDIO SHODWE

Future Ideas

Enhancing Dataset Diversity

e.g., Broader datasets incorporating varying disease severities.

Resource-Efficient AIModels

Optimize models for resource-limited environments (e.g., mobile devices).

Fostering Clinical Trust

Improve model interpretability for clinical trust

Expanding Application Scope

Extend methodology to other diseases (e.g., tuberculosis, lung cancer).

THANK YOU!