# COVID-19 Detection from X-Ray images of the lungs using Convolutional Neural Networks

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***Abstract*- In 2020, humanity is facing one of the greatest challenges ever seen in the form of virus (Covid-19). An unprecedented pandemic that has millions of people confined to home. In this research, the possibility of detecting this virus in people using X-Ray images of the lungs is studied. (i) A public dataset containing images from Covid-19, viral pneumonia and healthy people is used with (ii) Convolutional Neural Network architecture to be able to differentiate between different medical situations. Finally, (iii) it is revealed graphically the regions on which the CNN focuses in order to determine the medical situations of the person.**

***Index Terms***- Covid-19, CNN, Deep Learning, pneumonia.

1. Introduction

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his article tries to investigate if it is possible to automatically detect Covid-19 by using X-Ray images from lungs. **This research does not want to make any medical claim about Covid-19**, because this is not our work and is not our purpose. Humanity is facing a global pandemic and there are currently thousands of scientist, doctors and specialist researching the causes of virus, its early and effective detection and a cure in the form of vaccine. This virus has millions of people confined to home, in order to prevent propagation and the increase in deaths, because this virus has a much higher death rate than originally everyone thought. Attending to experts, the main symptoms of the virus are the following: sore throat, cough, fever and difficulty breathing (in severe cases). **In most of the severe cases, the virus is capable of causing pneumonia in the patient.** One of the techniques used to detect pneumonia are X-Ray images of the lungs, among many other. But, is this pneumonia easy to detect? Can we differentiate between a viral pneumonia and a Covid-19 pneumonia?. These two questions are the one that this research is trying to solve. In order to investigate these questions, some deep learning techniques are applied.

Deep learning techniques are intended to extract features and classify complex problems from a huge number of samples. Nowadays, there are many public architectures of Neural Networks that are able to extract these complex features from the samples given to the network and generalize the results with other samples that the network has never seen. In the case of images (X-Ray), the network typically used for predicting and classifying receives the name of **CNN (Convolutional Neural Network**). This network is able to extract features from a fix size image and distinguish between different classes. When we talk about classification, we can focus on two different types: binary classification and multiclass classification. The first one tries to classify between two different classes (e.g. dogs and cats) and the second one between three or more classes (e.g. sad, happy, angry, neutral, etc). In the state of the art, there are many pretrained and deep networks that you can apply to face and solve many problems. Actually, there are some researches about pneumonia detection using X-Ray images and CNN, but they are trained with a huge number of samples.

Those were the reasons why we chose to create and deploy a custom CNN from scratch, using less than 3.000 samples of X-Ray images from healthy, viral pneumonia and Covid-19 people found in a public database. In section (II) we describe this public database, mixing this type of examples and having unbalanced classes from Covid-19 images. In section (III) we present the method applied to solve the problem and predict the type of pathology in each image. Section (IV) talks about the experiments and results we went through, as well as presenting some insights extracted from these experiments. Finally, in section (V) we present the conclusion of the research.

The article structure is the following:

1. Introduction
2. Database
3. Method
4. Experiments and results
5. Conclusion
6. Database

The database has been downloaded from a public Kaggle link\* found in internet.



Fig1. Examples from the database.

A team of researchers from Qatar University, Doha, Qatar and the University of Dhaka, Bangladesh along with their collaborators from Pakistan and Malaysia in collaboration with medical doctors have created a database of chest X-ray images for COVID-19 positive cases along with Normal and Viral Pneumonia images. In their current release, there are **219 COVID-19 positive images**, **1341 normal images and 1345 viral pneumonia images**. They will continue to update this database as soon as they have new x-ray images for COVID-19 pneumonia patients.

1. Method

Empezar introduciendo brevemente que es una CNN, el funcionamiento general y luego explicar la arquitectura final propuesta, con una imagen y comentando todos los parámetros utilizados. Comentar que se ha utilizado keras sobre tensorflow para crear la arquitectura, que se han hecho distintas pruebas que veremos en la sección de experimentos y resultados.

1. Experiments and Results

Comentar en orden cronológico todos los experimentos a destacar que hemos ido haciendo, poner una tabla con todos los resultados y comentarlos uno a uno: sin data augmentation, con data augmentation (explicar como y por qué lo hemos hecho, ya que covid19 estabad desbalanceado respecto a las otras clases), nuevas arquitecturas, etc. Intentar sacar conclusiones de los porcentajes tanto generales como individuales. Después poner ejemplos y fotos de donde se está fijando la red en los pulmones para sacar esos resultados, intentar dar un por qué.

1. CONCLUSION

A conclusion section is not required. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

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