DEEP CONVNET FOR COVID 19 DETECTION FROM CT SCAN IMAGES

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ABSTRACT

In this paper, we describe the approach followed in classifying the IEEE ICASSP Signal Processing Grand Challenge (SPGC) dataset, containing CT scans of Covid19 and Cap patients as well as Normal CT scans. Images that are in (DICOM) format were first converted into jpeg for easier manipulation of the images in the dataset. The network VGG16 was adopted in the training phase. Additionally, the focal loss was adopted instead of cross-entropy to deal with the imbalanced data, and finally, classification occurred on a patient-level, and results were put in three CSV files corresponding to each of the three test folders available in the dataset.

***Index Terms*—** Deep ConvNet, COVID19, Deep Learning

1. INTRODUCTION

A strain of coronavirus that has not previously been detected anywhere has been an ongoing outbreak in the recent year. It is a pandemic that is known to be very dangerous and fatal especially for people with chronic diseases. Hence, continued research and learning about this topic has never been more important. This highly contagious disease can easily spread, and if not controlled in a timely fashion, can rapidly incapacitate healthcare systems. Computed Tomography (CT) scans [1] has shown discriminative features compared to other diagnostic tests, specifically, the Reverse Transcription Polymerase Chain Reaction (RT-PCR) test. In particular, CT scans consist of multiple cross-sectional images of the body (slices), which are seen together to create a 3D representation of the body. As such, CT scans can provide a comprehensive/informative illustration of the detailed structure of the lung and infected areas. Hence another solution was taken to help with the condensation of patients in the medical centers and hospitals and to reduce the stress caused to medical staff. Some paper proposed using machine SegNet which is a scene segmentation network and U-NET which is a medical segmentation tool and they both gave good performance whether in binary segmentation or in multi class segmentation [2]. Other researchers proposed using VGG16 and attention model. Their was trained in an end-to-end fashion [3]. In this paper, we finetuned VGG16 pretrained on Imagenet for training. Additionally, the focal loss was instead of cross entropy loss because the dataset is highly imbalanced.

The rest of the paper is organized as follows: In section 2, we describe the Dataset.The proposed solution is explained in section 3. Experimental setup and Results are illustrated in section 4. Finally, section 5 concludes

2. DATASET

The COVID-19 SPGC Dataset contains CT scans of Three classes of which are Covid-19 patients, Cap patients, and Normal cases, Covid19 (collected between February 2020 to April 2020),Community-Acquired Pneumonia(CAP)(collected between April 2018 to December 2019), and Normal (collected between Jan 2019 to May 2020). The data is in the Digital Imaging and Communications in Medicine (DICOM) format. Hounsfield Unit provided the data, and it was reconfigured into images with sizes 0f 512*512. Diagnosis of Covid19 patients is based on clinical parameters and the clarification of three experienced thoracic radiologists . The CT scans were collected from different scanners of different centers using different slice thickness.30 % of the data is randomly chosen for validation. Labels won't only be taken at a patient-level, but also, the radiologist analyzed a subset of 55 COVID19, and 25 CAP cases to the label to identify infection. The labeled subset of the data contains 4, 993 number of slices showing infection and 18, 416 number of slices without infection. Figure 2 shows The dataset is then divided into training, validation, and test sets that are identified as follows: Firstly, the Training and Validation Dataset includes volumetric CT scans with all slices of 171 patients positive for COVID-19, 60 CAP, and 76 normal cases. CT scans in this dataset are obtained by a SIEMENS, SOMATOM Scope scanner. A subset of 55 COVID19, and 25 CAP is labeled. Secondly, the Test data set is described as follows: Covid and Cap were collected from the same medical centers as the training and validation dataset. A slice of 2mm was taken for the Low dose CT scans of Covid 19 and normal cases, and finally a data of Covid19 , CAP, and normal was collected from people with heart disease history or operation.

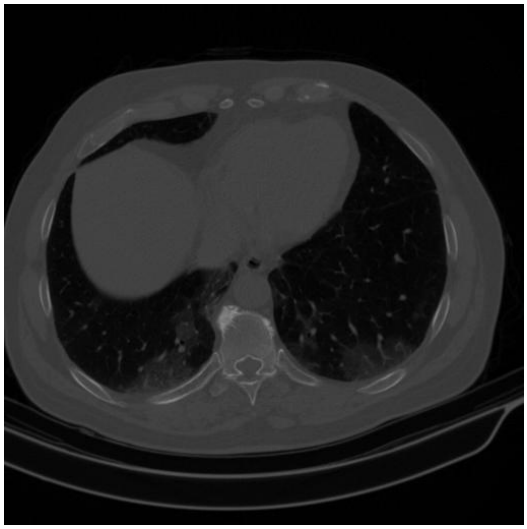

Fig. 1. Example of Covid19 CT from the SPGC Dataset.

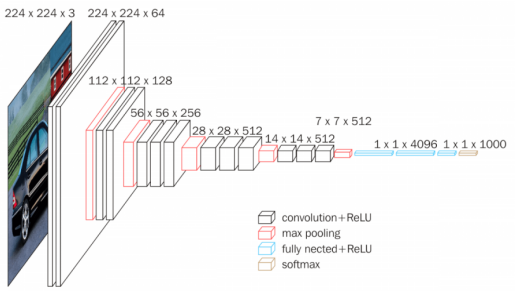

Fig. 2. The VGG16 Network.

3. PROPOSED SOLUTION

Firstly, data was converted from the medical format (DICOM) into JPEG format. This format is widely used as it reduces image size with keeping its quality, also it is easier to manipulate the data using this format. VGG16 [4] is widely used for image recognition. Firstly, we finetuned the network from a pretrained network on ImageNet. Secondly, since this dataset sufferes from class imbalance problem, Focal loss (FL) [5] was adopted. It is an improved version of cross entropy as it gives more weights to easily misclassified examples (less likely to be predicted) and gives less weights to easy examples (more likely to be predicted).

3.1. Focal loss

The Dataset was imbalanced. Hence, focal loss [5] was needed as it gives high weight for the examples that are more likely to be misclassified or less likely to occur and gives lower wight to easy examples. The focal loss is expressed as follows:

$$Loss = -\alpha_t(1-p_t)^\gamma \log(p_t), \quad (1)$$

where alpha is a prefixed value between 0 and 1 to balance the positive labeled samples and negative labeled samples and $\gamma \geq 0$ is a prefixed positive value.

4. EXPERIMENTAL RESULTS

Our network was trained on the labeled slices from COVID19 and CAP to classify the slices into one of 3 classes COVID19, CAP, or Normal. It achieved 59 % on the validation set. At the testing phase, a majority voting was executed on each patient to determine whether the subject is diagnosed with COVID19/CAP/ Normal.

5. CONCLUSION

This project of a multi-class classification based on a dataset consisting of medical images was a very good practise for real world problem with validation accuracy 59% , and finally a multi class classification was executed on each patient in each Test class.

6. REFERENCES

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