Pathology Detection

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Abstract-- **Optical coherence tomography (OCT) is an emerging medical technology for performing high-resolution cross-sectional imaging. Optical coherence tomography uses light waves to look inside a living human body. It can be used to evaluate thinning skin, broken blood vessels, heart diseases, and many other medical problems. Retinal optical coherence tomography is an imaging technique used to capture high-resolution cross sections of the retinas of living patients. Approximately 30 million OCT scans are performed each year, and the analysis and interpretation of these images takes up a significant amount of time. Computer vision is emerging in healthcare. The amount of data that pathologists analyze in a day can be too much to handle. Luckily, deep learning algorithms can identify patterns in large amounts of data that humans wouldn't notice otherwise. It can detect various diseases in plants, animals, and humans. For this application, the goal is to get datasets from Kaggle OCT and classify data into different sections.**

***Index Terms*— artificial intelligence, transfer learning, deep learning, age-related macular degeneration, choroidal neovascularization, diabetic retinopathy, diabetic macular edema, screening optical coherence tomography, pneumonia**

I. Introduction

Retinal optical coherence tomography (OCT) is an imaging technique used to capture high-resolution cross sections of the retinas of living patients. Approximately 30 million OCT scans are performed each year, and the analysis and interpretation of these images takes up a significant amount of time. Luckily, deep learning algorithms can identify patterns in large amounts of data that humans wouldn't notice otherwise. It can detect various diseases in plants, animals, and humans.

II. Problem Definition

Optical coherence tomography (OCT) is an emerging medical technology for performing high-resolution cross-sectional imaging. It uses light waves to look inside a living human body. It can be used to evaluate thinning skin, broken blood vessels, heart diseases, and many other medical problems. Approximately 30 million OCT scans are performed each year, and the analysis and interpretation of these images takes up a significant amount of time. The amount of data that pathologists analyze in a day can be too much to handle. Luckily, deep learning algorithms can identify patterns in large amounts of data that humans wouldn't notice otherwise. For this application, the goal is to get OCT images from Kaggle dataset and predict the type of eye disease. Our project can classify the images into 3 types of diseases.

- Normal
- Diabetic Macular Edema
- DRUSEN
- Choroidal Neovascularization

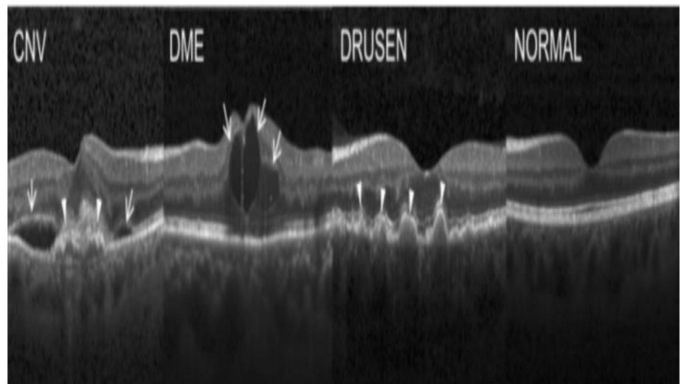

Fig 1

This model has significant business value for hospital and diagnostic centers, where it can aid doctors taking an informed decision towards his patients.

III. Network Architecture

In our model, we will be using spatial separable convolution and depth wise separable convolution network. The spatial separable convolution is so named because it deals primarily with the spatial dimensions of an image and kernel: the width and the height. (The other dimension, the "depth" dimension, is the number of channels of each image). A spatial separable convolution simply divides a kernel into two, smaller kernels. The most common case would be to divide a 3x3 kernel into a 3x1 and 1x3 kernel, like so: Now, instead of doing one convolution with 9 multiplications, we do two convolutions with 3 multiplications each (6 in total) to achieve the same effect. With less multiplications, computational complexity goes down, and the network is able to run faster.

The main issue with the spatial separable convolution is that not all kernels can be "separated" into two, smaller kernels. This becomes particularly bothersome during training, since of all the possible kernels the network could have adopted, it can only end up using one of the tiny portions that can be separated into two smaller kernels.

Depth wise Separable Convolutions, unlike spatial separable convolutions, depth wise separable convolutions work with kernels that cannot be “factored” into two smaller kernels. Hence, it is more commonly used. This is the type of separable convolution seen in keras. layers. SeparableConv2D or tf. layers. separable_conv2d.

The depth wise separable convolution is so named because it deals not just with the spatial dimensions, but with the depth dimension — the number of channels — as well. An input image may have 3 channels: RGB. After a few convolutions, an image may have multiple channels. You can image each channel as a particular interpretation of that image; in for example, the “red” channel interprets the “redness” of each pixel, the “blue” channel interprets the “blueness” of each pixel, and the “green” channel interprets the “greenness” of each pixel. An image with 64 channels has 64 different interpretations of that image.

Similar to the spatial separable convolution, a depth wise separable convolution splits a kernel into 2 separate kernels that do two convolutions: the depth wise convolution and the pointwise convolution. But first of all, let’s see how a normal convolution works.

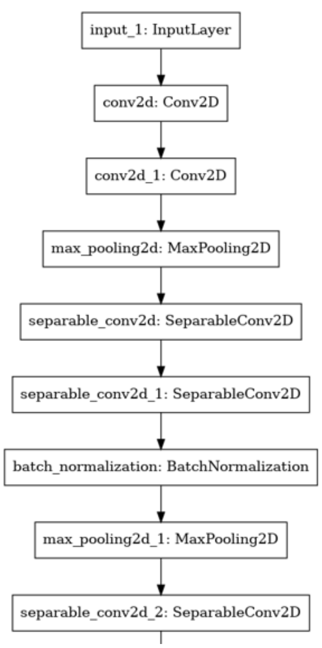

Fig 1.1

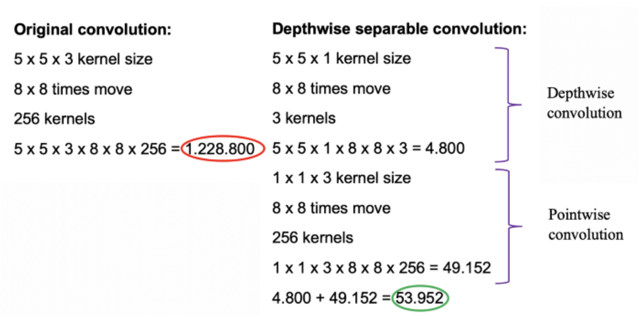

Fig 1.2

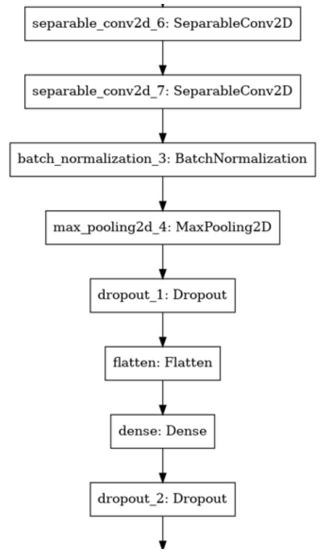

Fig 1.3

IV. System Architecture

There are 3 major components in the system architecture

Client side: React.js, HTML5/CSS3

Server Side: Node.js, Express.js

Database: AWS S3 Bucket

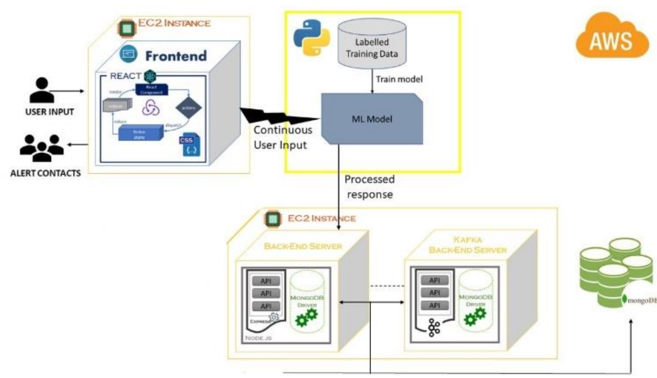

Fig 1.4

V. Problem Solution

Optical coherence tomography (OCT) is an emerging medical technology for performing high-resolution cross-sectional imaging. Optical coherence tomography uses light waves to look inside a living human body.

Approximately 30 million OCT scans are performed each year, and the analysis and interpretation of these images takes up a significant amount of time. We built a pipeline where a user can input an OCT image and get an automated prediction result with a confidence value.

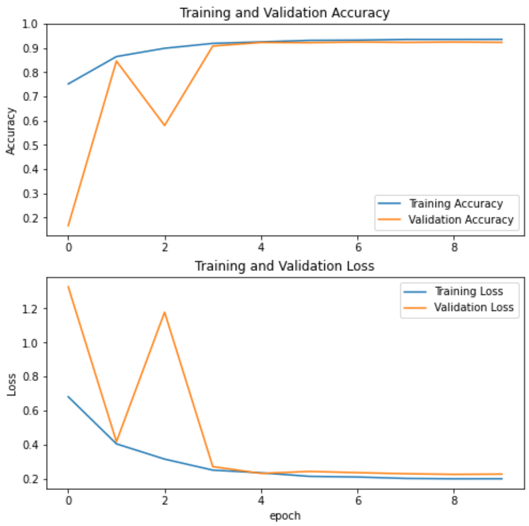

Fig 1.5

VI. Future Work

We plan to retrain and fine tune the model with more advanced neural networks such as Efficient Net.
We are planning to build more intuitive user interface and also a user can get in touch with a doctor around his city.
We also plan to train our model on different data sets to broaden our scope of problem statement and classify on more diseases.

VII. Conclusion

Computer vision is emerging in healthcare. The amount of data that pathologists analyze in a day can be too much to handle. We were able to build a machine learning model which was successfully able to predict the diseases with an accuracy of 93%, which was developed using the techniques such as separable and depth wise convolution networks.

VIII. DELIVERABLES

Github Repository:
https://github.com/sjsucmpe272-fall21/Pathology-Detection

IX. References

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