The Use of Deep Learning to Diagnose Tumors and Cysts in Kidneys

Introduction:

Medical imaging has advanced significantly, enabling detailed examination of the human body. Kidney CT scans play a crucial role in identifying abnormalities like tumors. However, distinguishing between normal kidney CT scans and those with tumors remains a challenge for healthcare professionals. Often, these CT scans can look almost identical, especially in the earlier stages of kidney cancer. Considering that earlier diagnosis of kidney cancer can be the essential to increasing life expectancy and curing the cancer, it can be very helpful for healthcare if the process of identifying tumors from kidney CT scans is automated.This research essay will explore the use of deep learning algorithms to automate this process to reach more accurate and fast diagnosis of kidney tumors. The aim is to develop an intelligent system that accurately identifies the presence of tumors in kidney scans.

Experiment:

In this experiment, Python and Keras were employed to design and implement a neural network using the Inception V3 architecture. A Kaggle dataset comprising CT scans of both normal kidneys and those with tumors was utilized for training the model. The neural network was fine-tuned to recognize patterns and features in the scans, enabling it to differentiate between normal and tumor-affected kidneys. After completing the training process, the model was rigorously tested using a separate test dataset to evaluate its accuracy and performance. The results obtained from this experiment hold some promise in enhancing the early detection of kidney tumors through automated analysis of CT scans, potentially benefiting patient diagnosis and treatment outcomes.

Results:

Multiple models were tested, until the final model specifications involving a learning rate of 0.001, 20 epochs, and a batch size of 5 was decided. These parameters yielded very consistent results with the machine being able to correctly identify 100% of the test images. However, it must be stressed that this success rate may not be reflected for CT scan images outside of the dataset that was used from Kaggle. In order to test the accuracy of the model for all CT scan images, a collection of 10 healthy kidney CT scan images and 10 kidney CT scan images with a tumor was tested. The model had a 100% accuracy rate with the normal kidney CT scans, however, the model was only able to correctly identify tumors in the CT scan images 50% of the time. To improve the model, the parameters must be adjusted and the used dataset must be expanded to include images that are outside the Kaggle dataset. In this way, the model will train from a wider variety of images and will get more accurate measurements, which is necessary if the model is to be used in a healthcare setting.

Conclusion:

In conclusion, this research project delved into the development of a neural network utilizing Python and Keras, alongside the Inception V3 architecture, to discern between normal kidney CT scans and those displaying tumors. Extensive model testing and optimization yielded highly consistent results, with a 100% accuracy in identifying test images from the kaggle dataset. Nonetheless, it is important to acknowledge that the model's performance may not fully generalize to CT scan images beyond the Kaggle dataset. The evaluation of an independent dataset comprising 10 healthy kidney CT scans and 10 kidney CT scans with tumors revealed 100% accuracy in identifying normal kidney scans, but only 50% accuracy in detecting tumors. To further enhance the model's potential and applicability in healthcare settings, parameter adjustments and a more diverse dataset are essential. Incorporating a wider range of CT scan images would enable the model to improve its accuracy in detecting tumors and contribute to early diagnosis and enhanced patient care. However, this research lays the foundation for future advancement and projects for the use of deep learning for kidney tumor identification and with adjustments and extensions can be used in medicine for the diagnosis of kidney cancer.