Medical Image Analysis

Martin Demel

Houston Community College

ITAI 1378 Computer Vision

August 28th, 2024

**Introduction / Personal Note**

From the very young age, I was amazed by computers and its application in real world. My Mom works in healthcare industry, and we would often discuss how and what they do in laboratory and how the use of computers supports their work. More recently, when we moved to USA, I met one of my very good friends Ray Maloney. Ray works as MRI Lead technician and as we share same passion for Technology and AI, we would always discuss what are the latest news in the industry. That is the main reason, why I have selected the Medical Image analysis as a topic.

**Background**

Medical Image Analysis utilizes computer algorithms to examine and interpret medical images into a meaningful outcome. Furthermore, I would like to share my understanding of how the analysis is applied in real life scenario. It all starts with gathering the data sets. That could include MRI, X-Ray, or CT scans and other imaging visuals collected by the imaging machines. Images are then examined by sophisticated algorithms throughout multiple steps which can include, image segmentation to isolate the targeted area, deep learning algorithms identifies patterns, Machine Learning and AI enhances the accuracy and significantly improve the SNR – Signal to Noise ratio; In other words, it provides faster and sharper images. Overall, the purpose is to improve diagnostics accuracy, time required for diagnosis by providing better, higher quality outcomes.

**Body**

When it comes to technology used for the analysis, it’s a little bit more complex than one could think. It requires multiple layers of analysis by applying Machine Learning, deep learning such as convolutional neural networks and transfer learning. These methods are then used in various tasks that can include object detection, image classification, 3D reconstruction, enhancement, segmentation and other image processing tasks. Once completed, the examination is combined into single set outcome that can be then interpreted by radiologist or medical technician.

While I was doing my research, I was particularly interested in MRI imaging as this is my favorite topic, we discuss with my friend Ray. When I heard that AI could contribute to up to 60% of reduction in time required to perform the scan I was left in shock. A 30-minute MRI scan of brain without the contrast would usually take 30 minutes; With AI, it shrank to only 10 minutes. Can you Imagine, how many more people can be scanned per day, week or month? This significant improvement can lead to dramatic decrease in waiting times. And as we know time is the essence when it comes to early detection. Even though this example is specific to MRI scan, overall improvement in image quality, detection of pattern that can’t be simply recognized by human eye are key benefits.

On the other hand, with benefits, we also have challenges. One challenge can be cost. It is not a secret that software required for MRI machine to perform advanced AI tasks can cost between $20,000 – $150,000. Secondly, there is a known problem and that is decision making understanding by AI, so called Black box. We don’t fully understand how and why the AI makes certain decision and that can be difficult to adopt or trust in modern medicine.

**Conclusion**

Looking back and moving forward, medical image analysis has still lot to offer, and we are at its very beginnings. The most recent developments in Technology & Healthcare industry area in the past 2 years has proven that we as human beings will benefit from the early, more accurate and accessible medical image diagnosis. At the same time, we must ensure advocacy for data privacy and security in the cloud world would not be forgotten. I believe that our pioneers Fei-Fei Li, Yann LeCun and others will ensure that.

Without that, the adoption will be significantly impacted. Or maybe not? People tend to take a risk when their life is at stake.

**Resources:**

<https://www.sciencedirect.com/topics/medicine-and-dentistry/image-analysis-medical-imaging>

<https://www.sciencedirect.com/science/article/abs/pii/S0010482523012428>

<https://www.sciencedirect.com/topics/computer-science/convolutional-network>

<https://www.sciencedirect.com/topics/computer-science/deep-learning-technique>

<https://www.forbes.com/councils/forbestechcouncil/2024/01/18/the-role-of-ai-in-healthcare/#:~:text=AI%20Use%20Cases%20In%20Healthcare,images%20and%20other%20medical%20visuals>.

Raymond Alvin Maloney 4th - ARMRIT