AI in Medical Imaging: Delivering Value and Optimizing Stakeholder Outcomes

Abstract

Improvements in technology combined with growing demands of patients and health care providers have led to an increase in the number of medical imaging procedures. However, the limited availability of trained radiologists is resulting in delays in diagnosis, higher error rates, and repeat imaging, adding significantly to costs and patient risks.

The paper expands on how new age technologies such as AI can be leveraged, guided by Business 4.0 concepts of automation and intelligence, to optimize patient as well as business outcomes. The result: enhanced ability to maintain the pace of medical imaging demand and radiology resource availability, while ushering in accuracy and cost efficiencies.

Introduction

Medical imaging analytics, a core function in the diagnostics industry, helps medical professionals identify and analyze medical problems based on different imaging modalities. Radiologists extract meaningful and clinically relevant information from various digital medical images such as X-rays, CT scans, and ultrasounds to support disease diagnosis and therapies. The data sets play a critical role in accurately ascertaining the condition of the body organ under examination.

The extensive use of medical imaging in the healthcare arena, however, poses several challenges as well as opportunities (see Figure 1). Medical images currently account for over 90% of all medical data and 50% of total ionizing radiation exposure. Even more alarming is the fact that more than 97% of this goes unanalyzed or unused[1]. The amount of data in the images is extensive, and extracting the required details, it could save significant time and money for patients, while decreasing their exposure to radiation and risk of complications from invasive procedures.

Even those images that are analyzed are not always accurate and are sometimes interpreted incorrectly by radiologists, leading to increasing costs and unnecessary medical procedures. 23% of patients are said to experience false positives on image readings, resulting in unnecessary invasive procedures and follow-up scans[2].

The other challenge faced by the diagnostics industry is the shortage of radiological talent. According to the report from NHS, the Royal College of Radiologists, nearly all radiology departments in the UK (97%) were unable to meet their diagnostic reporting requirements[3]. The gap has further increased over the past few years. As per Royal College of Radiologists, the Medical imaging related workload has increased by 30% between 2012 and 2017, but the number of consultant radiologists has increased at half the pace only during the time period[4]. Authorities are attributing the increase in mortality rate to delays in detection of life threatening clinical conditions such as cancer. Added to this, advances in imaging technology have significantly increased image resolution, increasing the need for radiologists to identify more intricate and granular details.

With the exponential increase in medical imaging over the years, radiology now accounts for a large portion of insurance dollar spend, forcing policy makers to examine and cut back on imaging payments. Clearly, addressing the issue of excessive radiology practices such as advanced or repeat imaging to rule out false positives is a top concern for all stakeholders - providers, insurers as well as patients.

Enhancing Medical Imaging Analytics Using Net-Gen Technologies

According to a recent report from PRNewswire, global medical image analytics market has a potential to reach USD[4].26 Billion by 2025[5]. Given the phenomenal growth rate, it is important to align new age technologies to address the challenges of the diagnostics industry. AI-powered deep learning is one area that can help address the issues such as handling extensive medical data, ensuring accuracy, and enabling bandwidth. The Economist found that over 50% of global healthcare leaders expect AI to play an expanding role in diagnosis.

What are the benefits of leveraging AI in medical imaging? Radiology relies heavily on the interpretation of visual data, making it an ideal candidate for AI-based predictive solutions. Using AI in the diagnostics industry can make diagnosis faster and cheaper. AI-powered algorithms can detect even subtle anomalies that are easily overlooked by humans.

Challenges	Implications	Opportunities
Radiologist resource crunch	Overload & Stress, Higher average error rates, Incorrect diagnoses, Inappropriate treatments	AI can support in repetitive task and simpler judgement, liberating workforce for high end jobs
Volumes of Medical Imaging Data	Data Management, Delay in analysis leading to high risk Medical conditions, High resolution images leading to growth of minute details that need to be captured	Smart systems for faster analysis and identifying the abnormal medical conditions precisely
Rising in Medical Imaging expenses	Diagnostics Industry need to enhance productivity, accuracy & precision	Deep learning empowering radiologists to extract extensive observation correctly in first imaging itself
Medical Imaging workflow are expenses	Slow process and inefficient	Assigning priority and optimizing human bandwidth available to high priority cases

Figure1: Medical Image Analytics: Challenges – Implications - Opportunities

Revolutionizing Medical Imaging with Business 4.0

Business 4.0 encompassing technologies such as AI and automation is redefining the way businesses address challenges and enhance outcomes. As a technology pillar of the Business 4.0 framework, AI can enable exponential value creation and risk mitigation in medical imaging. Here's how. AI offers various potential use cases across medical imaging analytics. AI-enabled intelligence and analysis helps radiologists clearly identify and segregate the area of medical interest from the rest of the image. For example, chemotherapy can be targeted just at the cancerous cells and not the adjacent healthy tissues. In the absence of AI, this is a complex and time-consuming process that requires laborious manual analysis. The application of AI can help automate the segmentation process to drive accuracy, speed, and precision.

AI-based algorithms segment a medical image at two levels. First, the system clearly identifies different body organs and then drills down to the organ under observation.

At the next level, it segments different types of problems within an organ such as lesions in the human brain. Clustering techniques help analyze multiple image formats, generated through different medical imaging techniques, to identify elements that significantly deviate from standard images. Deep learning is especially important in enabling commercially viable solutions as convolutional neural networks enable highly accurate image classification and high performance.

The AI-based method is highly accurate as compared to other computer vision-based methods for body organ recognition. Though it requires large training data and computational power, the emergence of affordable high power computing makes this the most optimal method for generating superior results.

In essence, it helps radiologists extract extensive inputs and minute observations correctly in the first imaging itself, reducing the need for further advanced imaging.

Benefiting All Stakeholders

The increasing adoption of AI in medical imaging is naturally leading to a growing concern among radiologists around job security. On the contrary, a Business 4.0 based solution that leverages digital technologies such as AI, cloud, and

automation, will require radiologists to continue to play an active role in medical imaging analytics. What's going to change is the type of tasks they will focus on.

Currently, radiologists are overloaded with the mundane task of reading and interpreting reports. AI powered diagnostic machines support humans in getting the job done quickly and at scale. This frees up the bandwidth of radiologists, allowing them to focus on high- value analysis of reports that are tagged as 'positives' by the smart machines.

Also, radiology involves many tasks - from preparing equipment for specific examination and administering targeted doses of radiation to reading and interpreting images. This involves deriving complicated findings from medical images. But only a few of the tasks can be automated through AI, as the new age technology comes at a cost. This means only specific tasks that are likely to benefit from AI-based automation must be identified through careful due diligence and cost benefit analysis.

Productizing AI for Medical Imaging

While AI could be a powerful tool that enables efficiencies in reviewing increased volume of medical images, its adoption will depend on the economic considerations of each case as well as organizational access to technology expertise. Its impact - in improving physician workflows and enabling faster examinations with more assertive diagnosis and treatment, ultimately delivering economic and healthcare benefits for all industry stakeholders - will be incremental rather than revolutionary. Faster enablement of next-gen technologies to help healthcare professionals get more out of existing resources will require a progressive mindset and collaboration from all stakeholders, including radiologists.

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