SOLUTION BRIEF

Healthcare
Intel® AI Technologies

GE Healthcare Accelerates Pneumothorax Detection at Point of Care with Intel® AI Technologies

GE Healthcare leverages Intel® Distribution of OpenVINO™ Toolkit to optimize AI inferencing of an X-ray image within seconds on Intel® processors

"GE Healthcare's vision is to drive more individualized, precise, and effective patient outcomes."

- Kieran Murphy, CEO, GE Healthcare

Executive Summary

Hospitals produce 50 petabytes of data per year.[1] A staggering 90 percent of that is medical imaging, and 50 percent of medical imaging data is from X-ray scanners.[2] This is a flood of data for radiology departments, resulting in potentially long turn-around-time (TAT)—even when the scan is considered stat. In critical conditions, such as pneumothorax, escalation of interpretation is essential to accelerate treatment.

GE Healthcare is developing artificial intelligence (AI) solutions across multiple radiology modalities to detect and help prioritize critical cases. Using Intel® AI technologies, GE Healthcare has optimized algorithms for Critical Care Suite*+ available on OPTIMA* XR240amx systems to scan X-ray images and detect pneumothorax within seconds—at the point of care.

Introduction

Radiologists' and radiology technologists' workloads are increasing as clinics and hospitals keep their imaging machines as busy as possible. When patients with potentially acute conditions need fast diagnosis based on image scans, radiologists must immediately reprioritize workloads to ensure patients with a potentially life-threatening condition, such as a pneumothorax, receive immediate treatment.

Artificial Intelligence – Technology to Help Improve Patient Care

Healthcare equipment providers, hospital Information Technology departments, and researchers are investing in artificial intelligence/deep learning (AI/DL) research and development to help streamline operational and clinical workflows, reprioritize critical cases, and improve patient outcomes. A recent survey of healthcare leaders shows that 37 percent are already using AI and 88 percent of them believe that it will improve patient care.[3]

Through its Edison AI Services*^ and Critical Care Suite+ software, GE Healthcare is leading the way in developing advanced solutions deployable on their radiology systems to detect potentially life-threatening conditions. GE Healthcare developed an AI algorithm with four clinical partners, including the University of California, San Francisco (UCSF), to identify and help prioritize scans of patients with pneumothorax using the OPTIMA XR240amx. Critical Care Suite+ on OPTIMA XR240amx is designed to help the clinical teams identify cases with potential pneumothorax at point of care to enable prioritization of image review. The mobile x-ray system, a first of its kind of AI-embedded imaging device, displays an onscreen notification to the radiology technologist, and results are sent to Picture Archiving and Communication System, which can help expedite critical findings.

+Critical Care Suite is 510(k) pending at FDA. Not available for sale in the United States.

GE Healthcare's innovative work in deep learning-based X-ray image analysis for pneumothorax is supported by computer vision tools from Intel. Optimizing the algorithm with the Intel® Distribution of OpenVINO™ Toolkit,[4] early testing has demonstrated the ability to accelerate pneumothorax detection to under a second—completed at the point of care on an imaging system with an Intel® processor. GE Healthcare is showing how optimized deep learning algorithms can transform imaging workflows.

Intelligent Pneumothorax Detection at Point of Care

One of the critical performance requirements for X-ray systems is patient throughput, usually represented as number of exams per hour. Patient positioning takes time and can be difficult to control. This means the rest of the tasks—setting up the exam in the machine's software and acquiring, previewing, and processing images—has to be done as quickly as possible to maximize the number of exams. Adding intelligent detection on the system (a process called inferencing) can slow down exams. Yet quick detection of pneumothorax at the point of care has clear patient benefits. Thus, GE Healthcare's target for intelligent pneumothorax inferencing and indication to the user was a few seconds on all processing for detection of any pneumothorax.

GE Healthcare's Pneumothorax Inferencing System

GE Healthcare's pneumothorax detection software is designed to be embedded in the X-ray system as part of the Critical Care Suite⁺ for machine-based inferencing. It comprises three models against which the image data is analyzed (Figure 1).

- Frontal chest model helps ensure the correct view (AP or PA) is being captured.
- Lung field positioning model looks for clipping of the lungs in the image.
- Pneumothorax model detects presence of pneumothorax.

The models are inferenced after the scan has completed. When a pneumothorax is identified, a notification in the user interface appears, and results are sent to PACS, which can help expedite critical findings.

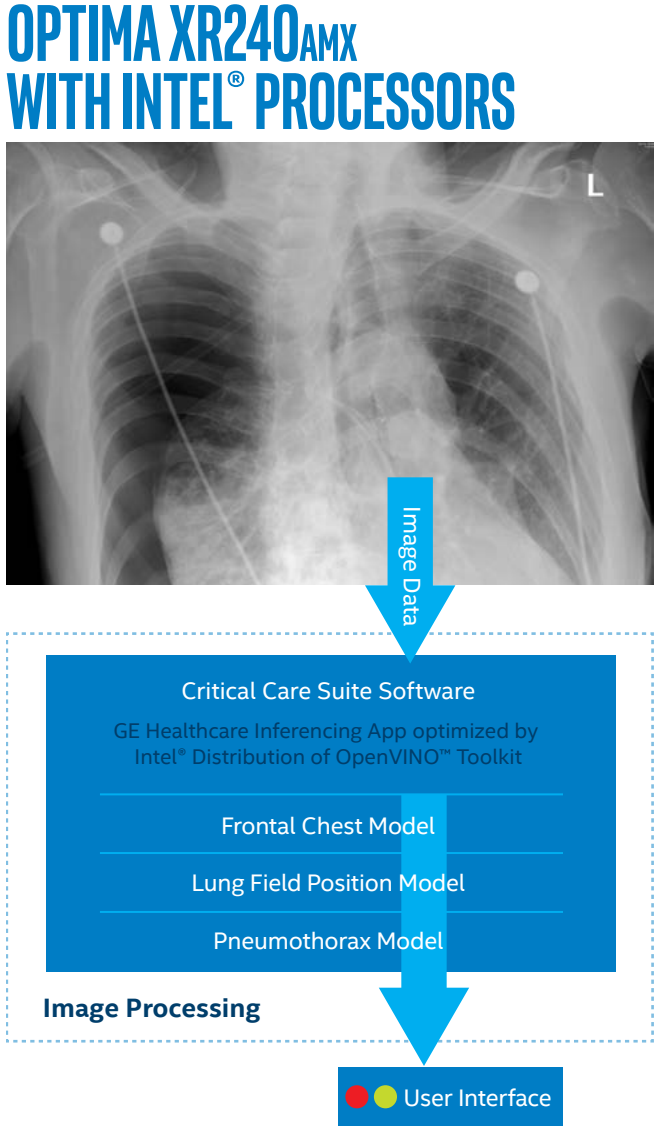

Figure 1. Pneumothorax detection software flow.

Intel Processors for X-ray Image Inferencing

Inferencing of image data is a computationally intensive process that runs complex calculations. Some equipment providers require an accelerator to be installed in the equipment to inference images, but this adds cost and complexity. Instead, GE Healthcare uses Intel processors with the performance to both operate the X-ray system and inference complex images for image quality checks, disease, or acute conditions such as pneumothorax. GE Healthcare's Critical Care Suite⁺ leverages the existing computing capability of the imaging system and enables inferencing through software upgrades, giving existing customers access to the latest and greatest AI features without having to retrofit the imaging system with additional hardware for performing AI inference.

⁺Critical Care Suite is 510(k) pending at FDA. Not available for sale in the United States.

GE Healthcare Inferencing Accelerated by Intel Distribution of OpenVINO Toolkit

Computer vision is the application of inferencing and analyzing data from imaging devices, such as digital optical cameras and many medical imaging modalities, including CT scanners, MRI scanners, Ultrasound, and X-ray. The Intel Distribution of OpenVINO toolkit provides computer vision and deep learning inference tools, including convolutional image-based classification models optimized for the Intel processors used in GE Healthcare imaging systems.

Intel Distribution of OpenVINO Toolkit

The toolkit maximizes performance of computer vision applications running on multiple types of Intel® hardware. Based on convolutional neural networks (CNNs), the Intel Distribution of OpenVINO Toolkit brings together several Intel software components used specifically for inferencing into a unique toolset, which is a free download for developers and data scientists.

Intel offers a range of hardware for inferencing, including Intel Core processors, Intel Xeon processors, Intel® FPGAs, and Intel® Movidius™ vision processing units (VPUs). The Intel Distribution of OpenVINO toolkit takes advantage of various Intel technologies built into Intel hardware to accelerate inferencing. GE Healthcare currently uses different Intel processors for different devices and is evaluating other products and future accelerators. OpenVINO allows them to infer these varieties of Intel inference hardware using the same software API (Figure 2).

GE Healthcare Edison AI Services and Critical Care Suite*

GE Healthcare Edison AI Services and Critical Care Suite* comprise a software architecture to advance the clinical adoption of deep learning and inferencing in healthcare in order to assist prioritization. Edison AI Services include the following:

- AI Workbench—API tools that ingest data, anonymize, annotate images, and build and test AI algorithms, at scale.
- AI Inferencing Service—Packaging, optimization and publishing of the AI algorithm for seamless and invisible deployment.

Edison AI Services and Critical Care Suite* enable deployment of intelligent detection of different diseases, conditions, and traumas.

GE Healthcare, collaborating with Intel computer vision developers, employed Intel Distribution of OpenVINO Toolkit to optimize inferencing of pneumothorax on its Intel processor-based X-ray systems. Their goal was to optimize the frontal chest, lung field position, and the pneumothorax inferencing processes for user indication of results within seconds of image acquisition.

INTEL® DISTRIBUTION OF OPENVINO™ TOOLKIT

Single Software Solution: Cross-platform inferencing acceleration to assist healthcare providers and improve patient outcomes.

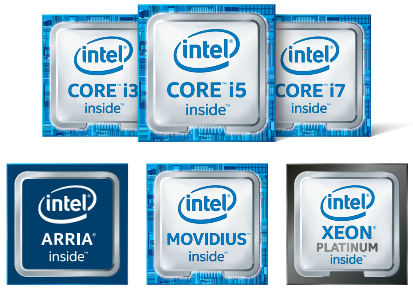

Figure 2. Intel® Distribution of OpenVINO™ toolkit optimizes workloads across multiple Intel® processors.

"AI is not a one-size-fits-all solution. It's about going beyond the imaging machine to make it intelligent with software..."

- Kieran Murphy, CEO, GE Healthcare

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Results

When GE Healthcare tested its models with the Intel Distribution of OpenVINO Toolkit, pneumothorax detection on the OPTIMA XR240amx X-ray system accelerated by 3.3X compared to inferencing without optimizations.[5] Optimizations by the toolkit improved performance across all models, with the pneumothorax model receiving the most benefit. Overall pneumothorax detection dropped from just over three seconds to under one second (Figure 3).

The Critical Care Suite+ was designed to achieve accuracy of over 0.95 area under the curve (AUC). With high accuracy of detection within seconds, GE Healthcare can enable fast AI-based solutions that can help prioritize critical cases without disrupting the technologist's workflow.

GE and Intel: Better Together for Healthcare

Many healthcare providers are already leveraging AI in their institutions to benefit patients, improve workflow efficiencies, reduce costs, and advance healthcare. GE Healthcare, working with Intel, continues to enhance research and advance radiology systems through innovative technologies and solutions. GE Healthcare's application of inferencing to detect pneumothorax is a critical step to advance AI in healthcare.

Through Edison AI Services and Critical Care Suite+, GE Healthcare's work in intelligent pneumothorax detection is only one area in which the company is developing deep learning solutions to run on its imaging systems. The company continues to develop other models for inferencing on multiple modalities at the point of care, with accelerated results using Intel processors and software.

Rather than a one-size-fits-all solution, Intel offers a powerful portfolio of scalable hardware and software solutions to meet the needs of all radiology systems. Intel's portfolio offers a range of processing capabilities for inferencing and computation to address the needs of any design. And, Intel continues to innovate in inferencing technologies, while standardizing its software tool suites, such as Intel Distribution of OpenVINO toolkit, across all of its silicon choices. This allows solution developers like GE Healthcare to choose the best hardware technologies for their solutions and ensure software portability across different hardware systems built on Intel products. A standardized approach allows easier upgrades and consistent software, contributing to improved reliability, reduced maintenance, and lower total cost of ownership (TCO).

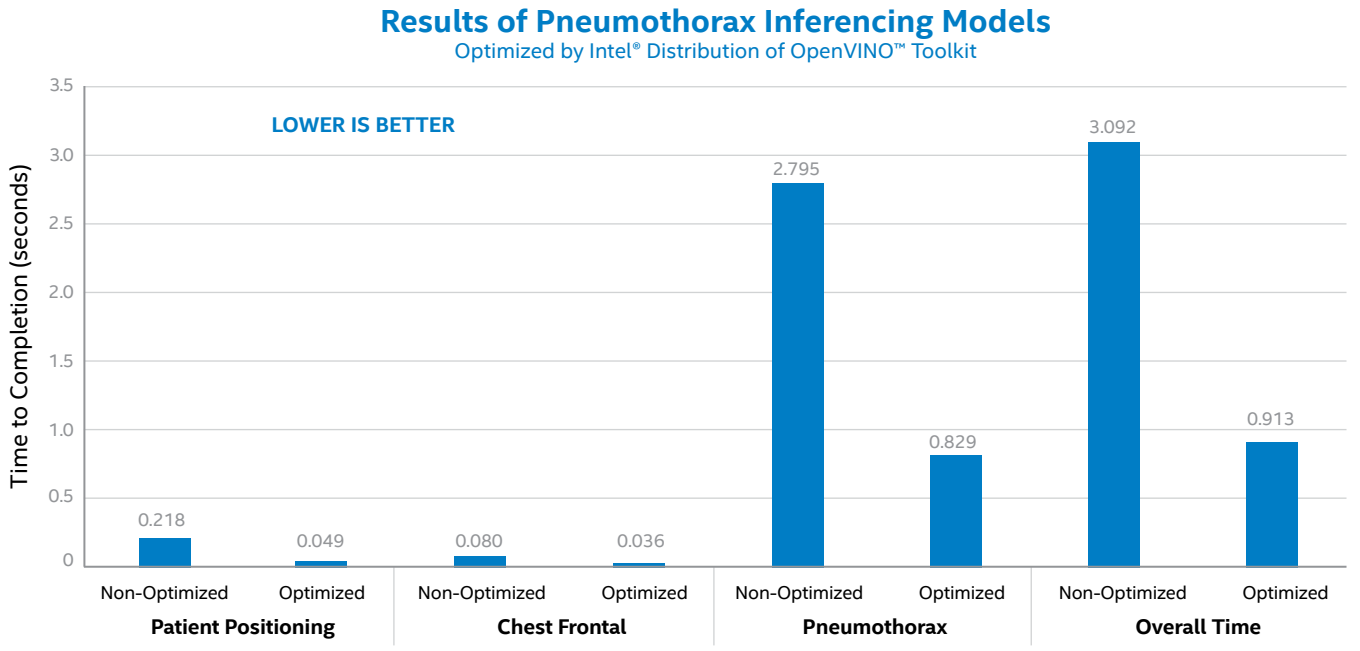

Figure 3. Results of Pneumothorax Inferencing Models.[5]

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For more information about GE Healthcare Critical Care Suite[+] and Optima XR240amx, visit **gehealthcare.com**.

For more information about Intel Computer Vision technologies, visit **https://software.intel.com/openvino-toolkit**.

For more on Intel AI technologies, visit **ai.intel.com**.

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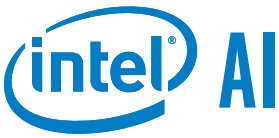

[1] http://newsroom.gehealthcare.com/beyond-imaging-ai-imaging-innovation/

[2] https://www.ge.com/reports/data-vision-x-ray-app-help-hospitals-cut-costs/

[3] https://newsroom.intel.com/news-releases/u-s-healthcare-leaders-expect-widespread-adoption-artificial-intelligence-2023

[4] Two versions of the free toolkit are available: Intel® Distribution of OpenVINO™ toolkit https://software.intel.com/openvino-toolkit and an open-source version called OpenVINO™ toolkit, https://01.org/openvinotoolkit.

[5] System test configuration disclosure: Intel® Core™ i5-4590S CPU @ 3.00GHZ, x86_64, VT-x enabled, 16GB memory, OS: Linux magic x86_64 GNU/Linux, Ubuntu 16.04 inferencing service docker container. Testing done by GE Healthcare, September 2018. Test compares TensorFlow? model total inferencing time of 3.092 seconds to the same model optimized by Intel® Distribution of OpenVINO™ Toolkit optimized TF model resulting in a total inferencing time of 0.913 seconds for 338% performance speedup.

[^] Edison AI Services are healthcare-specific services enable GE Healthcare's internal developers and strategic partners to design, develop, manage, secure and distribute advanced applications. These services are not for sale or otherwise commercially available.

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