Hewlett Packard Enterprise

BUILDING A BETTER X-RAY THROUGH MACHINE LEARNING

How Carestream created an AI-powered ecosystem that helps improve patient outcomes

Medical science is a data-driven field for a reason: better data means more accurate diagnoses. But the process for capturing high-quality images is inherently complex and subject to variability. It's one of the reasons why Carestream Health developed Eclipse, the engine that powers its solutions for imaging, workflow, and analytics intelligence. Eclipse utilizes AI in numerous medical imaging and workflow capabilities to help power informed diagnoses.

Diagnosis is in the details

No diagnostic imaging technology has been as long-lived as general radiology. Physicians rely heavily on these observations to make their diagnoses. It only makes sense that imaging physicists are continually pushing the boundaries of what these technologies can deliver, but variables remain when it comes to capturing a pristine radiograph.

"Medical imaging systems can fail to generate qualified diagnostic images for various different reasons, including incorrect positioning of the patients or the systems," says Dharmendu Damany, Chief Technology Officer at Carestream Health. "Carestream is laser focused on providing as much detail as possible in a medical digital image or an X-ray film so that radiologists have the information, they need to make a confident diagnosis."

Improving the quality of imagery is a complex undertaking that requires as much attention to digital image optimization as it does to the conditions in the room where X-rays are being taken. For Carestream, implementing artificial intelligence (AI) solutions that streamline the diagnostic imaging process is about improving the entire workflow.

Carestream

INDUSTRY: HEALTHCARE

REGION: UNITED STATES

VISION

Create a medical imaging environment that helps improve radiology workflow, informed diagnosis, and patient care

STRATEGY

Build an AI ecosystem for continuous learning while meeting strict security and compliance requirements

OUTCOMES

- Delivers 73% reduction in training times for machine learning (ML) models (16 hours vs. 60 hours)
- Captures valuable ML data while keeping sensitive patient details private
- Improves patient care by assisting diagnoses and reducing the need for image retakes

Building an AI ecosystem

To minimize some of the variables inherent to imaging, Carestream built its Eclipse Engine with AI solutions for Imaging Intelligence, Workflow Intelligence, and Analytics Intelligence, enhancing many of the steps commonly taken from the exam room to the physician's office. Combining automated radiography equipment, digital image enhancement technology, and the analytics necessary for healthcare organizations to have insights at the highest level, the Eclipse Engine enables the ecosystem that puts patient outcomes first.

"The primary driver for implementing AI technology in radiology includes the need for greater productivity, improved image quality, reduced radiation dose—and most importantly—improved clinical care and outcomes," Damany explains. "Our goal is to make the digital capture process as efficient and consistent as possible. This gets the diagnostic images into the hands of radiologists and physicians faster so they can begin treatment for patients sooner."

The Eclipse Engine drives Carestream's Smart Room offering which automates machine positioning, exposure settings, and patient pose verification. Together with Carestream DRX-Compass and DRX-Evolution Plus imaging systems, the Eclipse Engine uses AI to help get imaging right the first time—reducing the need for X-ray retakes and limiting unnecessary radiation exposure.

Once X-rays are captured, the Eclipse Engine leverages AI algorithms to improve image quality. One example is smart noise cancellation that provides improved diagnostic quality, preservation of fine detail, and better contrast-to-noise ratio for images acquired at clinically nominal exposures.[1]

Paving the way for continuous improvement

To deliver, manage, and update software applications within the Eclipse Engine to meet customers' growing clinical and operational needs, Carestream is developing new AI-based applications. And of course, those AI solutions need to incorporate new learnings to improve their algorithms.

To make it happen, Carestream needs a secure environment where it can build these algorithms on de-identified diagnostic images provided through agreements with customers. "To ensure and improve real-world performance, we need data to improve algorithms. At the same time, we need to ensure that data privacy and security are maintained without the transfer of sensitive data," Damany posits.

Carestream needed a platform to take the guesswork out of operational and compliance requirements so it could focus on its core business strategy. "Our focus is on building AI solutions that help solve the complex problems our customers have—not on the ecosystem that provides the plumbing for how that data comes back to us," Damany explains.

[1] These statements were verified using Carestream detectors in a reader study performed by board-certified radiologists comparing pairwise images taken at nominal dose (CsI ISO 400 speed / GOS ISO 320 speed) and reduced dose (CsI ISO 800 speed / GOS ISO 500 speed) with SNC.

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>
> – **DHARMENDU DAMANY**, CHIEF TECHNOLOGY OFFICER, CARESTREAM

Machine learning as a service

To make it faster, easier, and more secure for Carestream to develop its AI solutions, Damany and team chose HPE GreenLake for ML Ops—a fully managed, enterprise-grade cloud service for ML. An important aspect for Carestream was for the AI platform to be built using "off-the-shelf" technologies and components. This approach aids in the transportability of the platform solution and enables use of best-in-class solutions from a variety of vendors.

Leveraging initial advisory services from HPE, Carestream is beginning to implement an AI-as-a-service platform to develop, deploy, monitor, and support AI models served to Carestream's edge imaging systems.

A specific aspect of the deployment challenge was born of the fact that X-ray devices are "air gapped"—meaning they are not in constant network contact. So, the solution had to account for this when considering how to get the monitoring data of AI model performance and for deploying updates.

Building a platform for innovation

The solution architecture HPE and Carestream designed overcomes this hurdle by delivering on-device, real-time implementation of the AI models and features necessary to achieve improved imaging results while still monitoring real-world model performance—a huge advantage for continuous improvement and ensuring compliance with regulatory requirements for AI-enabled solutions.

The solution is built on HPE Apollo 6500 systems, HPE Apollo 4200 data storage servers, and powered by HPE Ezmeral Runtime Enterprise, HPE Ezmeral ML Ops software, and HPE AI and Data Transformation Services . The platform allows Carestream to consume these resources on-premises with a cloud experience. The ML environment is managed by HPE GreenLake Management Services.

Now Carestream's data scientists can focus on building models instead of managing and configuring infrastructure. "Our subject-matter experts apply technology to solve complex problems," Damany says. "The addition of expertise from HPE GreenLake acts as a multiplier to our efforts and accelerates improved outcomes. We are already seeing reduced cycle time for AI model creation and optimization."

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Optimizing the present and the future

When Carestream was optimizing its image enhancement algorithm earlier this year, the partnership with HPE had already started to show its value.

"We had a significant reduction in time to execute training runs for our AI-driven Smart Noise Cancellation solution: from 60 hours to 16 hours. We expect this time to continue to decrease significantly," Damany explains.

Because training an AI algorithm to enhance images for diagnostic use is a time-and-computation intensive exercise, the benefits of faster turnaround are many. "The HPE GreenLake for ML Ops platform will enable Carestream to reduce our AI-related research costs, and ultimately deliver innovative solutions to the healthcare market more quickly."

One way that could happen in the future is for Carestream to begin offering its AI ecosystem in a consumption-based model.

"We'd like to take our offerings to the next level where our business moves from device-centric solutions to more of an as-a-service model," Damany says. "Working with HPE, we are building a framework that will ultimately allow us to transition there."

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SOLUTION

HPE GREENLAKE PLATFORM

- HPE GreenLake for ML Ops

HARDWARE

- HPE Apollo 6500 systems
- HPE Apollo 4200 Gen10 server

SOFTWARE

- HPE Ezmeral Runtime Enterprise
- HPE Ezmeral ML Ops

HPE POINTNEXT SERVICES

- HPE AI and Data Transformation Services

KEY PARTNERS

- SUSE
- NVIDIA®

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