

Harnessing AI to Transform Diabetic Retinopathy Diagnosis & Treatment

Sankara Eye Foundation, in collaboration with Leben Care, maximized Intel® architecture to minimize vision loss through faster and accurate detection of diabetic retinopathy.

“ Technology and AI are democratizing healthcare access, especially in screening for ailments. Our team at Sankara Eye Foundation has focused on our vision to eliminate needless blindness from India. The current solution Netra.AI - where we had a key role in the design and development with Leben Care - uses robust platforms from Intel. It is an example of how like-minded collaborators can create meaningful and impactful solutions for various challenges that face humanity. ”

Dr. Kaushik Murali

President, Medical Administration,
Quality & Education,
Sankara Eye Foundation India

Sankara Eye Foundation India, is a pan India, non-profit organization with the mission to eliminate preventable and curable blindness through a service-oriented team. One of the major reasons for avoidable blindness in adults in India is diabetic retinopathy (DR). To address this issue, Sankara Eye Foundation collaborated with Singapore-based Leben Care, to deploy a cloud-based AI software platform - Netra.AI. Built on Intel-powered technologies, Netra.AI can help identify retinal conditions in patients in a very short span of time with the accuracy level of human doctors, using deep learning.

Challenge

India has one of the largest diabetic populations of any country in the world, approaching the alarming mark of 98 million cases by 2030.¹ DR is the major cause for blindness and vision loss in persons of working age. Hence, early detection and treatment are critical to stopping the damage. However, with majority of the population based in rural India, the lack of well-trained ophthalmologists to identify DR – especially in remote rural regions – is a major concern. Also, there remains a huge gap in the number of patients and the needed medical care and infrastructure available in the country.

Solution

To address this challenge, Sankara Eye Foundation collaborated with Leben Care to implement a cloud-based AI solution based on the Intel® Xeon® Scalable processor platform, powered by Intel® Deep Learning Boost (Intel® DL Boost). Intel® DL Boost enables these processors to take embedded AI performance to the next level. By combining the power of the Intel Xeon Scalable platform, DL Boost and Intel® AVX-512 with Amazon EC2 C5 instances, Leben Care was able to deploy its intelligent solution - Netra.AI, a comprehensive retina risk assessment software-as-a-service platform available on cloud. It has the ability to identify healthy retina from an unhealthy one, which makes it a great tool to screen retinal disorders in a large population with limited infrastructure and resources for tertiary healthcare.

Result

Intel architecture-based Netra.AI enabled Sankara Eye Foundation to accurately detect DR to enable treatment in order to avoid further loss of vision and minimize the incidence of blindness. The comprehensive report generated by Netra.AI within 2 minutes of uploading the images enables optometrists or imaging technicians to provide instant counsel for patients needing a referral to the hospital. The solution also delivers excellent sensitivity and accuracy while detecting any DR, i.e., **99.7% and 98.5%** respectively.²

Innovating to Minimize Vision Loss Caused by DR

The need for proper diabetic screening to reduce the burden of DR-related blindness is growing in India. However, the paucity of trained retinal specialists in India limits effective screening of asymptomatic patients, thereby resulting in patients presenting late with advanced diabetic eye disease. Fundus photograph-based DR screening, in lieu of physical screening, can be performed using manual grading of fundus images by trained graders or retina specialists. Using AI technology to detect DR has opened a new front for DR screening and is improving rapidly. The application of this technology to diagnose referable DR patients has a great impact in reducing blindness in patient outcomes.

In the current landscape, every diabetic patient needs to be referred to a retina specialist for management and treatment of DR. Sankara Eye Foundation India used Netra.AI based on Intel architecture to precisely identify sight-threatening DR and succeeded in greatly reducing the burden of screening on vitreoretinal (VR) surgeons.

Developed by Leben Care in collaboration with Sankara Eye Foundation India, Netra.AI is a comprehensive retina risk assessment software-as-a-service platform that is available in the cloud. Images of patients' eye are captured using fundus cameras and then uploaded to the machine learning (ML) based platform, which receives anonymised patient data either via a web portal or through an API. Through these images, Netra.AI can diagnose retinal conditions like DR, glaucoma, macular degeneration and other retinal pathologies, which require immediate medical attention.

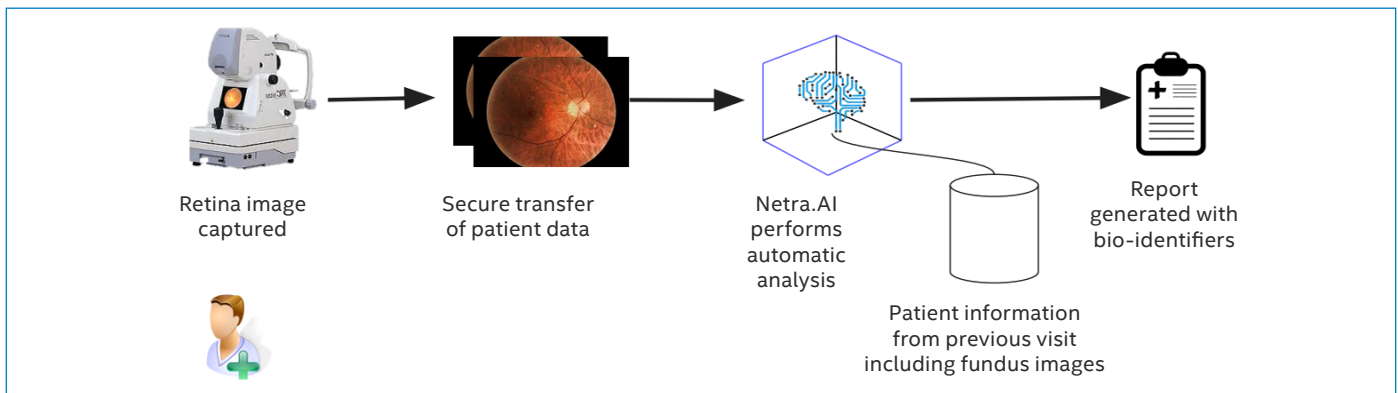


Figure 1: Netra.AI Solution Overview³

Netra.AI, which has been trained to be device-agnostic to specialized low-powered microscopes with attached cameras, provides the option to be used as both online and offline modules, such as a standalone box. The solution uses cutting-edge algorithms, developed in collaboration with leading retina experts, with a four-step deep convolutional neural network (DCNN). This neural network helps in detecting retinal photographs from non-retinal images, sensing generic quality distortion for automated image quality assessment, detecting the DR stage. It also helps in annotating the lesions based upon pixel density in the fundus images.

The solution has the ability to identify normal retina from an abnormal one, which makes it a great tool for screening of retinal disorders in a large population, especially one with limited infrastructure and resources for tertiary healthcare. The model is trained to identify different stages of diabetic retinopathy, and suggest whether the patient may need an early referral or regular monitoring. Furthermore, it can identify glaucoma, which can be a great tool for early screening of this progressive disorder that leads to blindness, and thus help in early treatment and control.

“ The use of AI to improve disease detection and prevention is a critical step for the healthcare industry and a giant leap for humankind. India has one of the largest diabetic populations in the world and Diabetic Retinopathy (DR) is the major cause for vision loss and blindness in persons of working age. The Intel-powered Netra.AI is a cloud-based AI solution that can scale rapidly to enable faster and accurate detection of retinal disorders in large populations with limited healthcare resources. Sankara Eye Foundation and Leben Care have leveraged the power of Intel® Xeon® Scalable processors and built-in Intel® Deep Learning (DL) Boost to accurately detect DR and enable timely treatment to effectively combat avoidable vision impairment and blindness in diabetic patients. ”



Prakash Mallya

Vice President and Managing Director of Sales, Marketing and Communications Group, Intel India



Image Quality

With real-time image quality assessment, Netra Screen can nearly eliminate loss of fidelity due to poor image quality.

Lesion Annotation

Netra Screen provides a great patient education tool along with insights to users.

Advanced Tools

Blood vessel segmentation and image post-processing empower users and specialists with greater insights to make fast and accurate diagnosis.

Figure 2: Netra.AI Key Features⁴

Powering Advanced AI Capabilities with Intel

Netra.AI maximizes Intel® processors for inferencing of the deep learning model in the production level. Leben Care leveraged Amazon Web Services (AWS) Elastic Compute Cloud (EC2) C5 and M5 instances, powered by Intel Xeon Scalable processors. The ophthalmology annotation platform and inferencing of multiple deep learning models, combined with TensorFlow Elastic Inference Accelerators (EIA), provided the ideal environment for running the advanced compute-intensive workloads. The Netra.AI solution leverages Amazon EC2 C5 and M5 instances featuring 2nd Generation Intel Xeon Scalable processors, because they deliver optimal price/performance across compute and memory compared to similar instances based on other processors.

Intel architecture also delivers strong data protection, fast processing of large data volumes, and service flexibility without any performance drawbacks. Intel Xeon Scalable processors provided the key capabilities needed to drive the Netra.AI solution, which include:

- **Intel Deep Learning Boost (Intel DL Boost)** offers built-in AI acceleration, with fast deep learning inference performance on image classification in 2nd Generation Intel Xeon Scalable processors.
- **Intel Advanced Vector Extension 512 (Intel AVX-512)**, offers accelerated application performance, enabling significant improvements in workload speeds and data applications.

Maximizing the Value of AWS Instances

Amazon EC2 C5 instances, with the computational power of Intel Xeon Scalable processors with Intel AVX-512 and Intel DL Boost, enable Leben Care to drive an intelligent, ML-powered Netra.AI solution. AWS provides users access to Intel-optimized images for TensorFlow, Apache MXNet, and PyTorch, in addition to Intel® Performance Libraries, to enhance application performance. Intel and AWS work together to make AI simple, accessible, and fast.

With Intel-based EC2 instances, which provide the ability to scale by providing the necessary computation power, Netra.AI is now able to provide retinal disorder risk reports in less than a minute, helping the optometrist and at-risk-patients with the insights required. For an optometrist, these insights can help identify when the retina scan must be repeated – due to bad image quality, or for an at-risk-patient getting referred to eye hospital for an immediate medical intervention.

Delivering High Impact Results

Netra.AI has screened 3293 patients worldwide to date and identified around 812 at-risk patients (24% referral rate).⁵ The report generated through Netra.AI not only provides timely identification of DR, but also allows the physicians to educate the patient using the images of the retina. This highlights the severity of the lesions and reinforces the need for treatment to avoid vision loss.

The solution does not replace ophthalmologists or retinal surgeons. However, through the easier accessibility of software and their integration with more portable fundus camera devices, which can be operated by a technician alone, this technology increases access for even a non-trained health professional to screen for DR. This outcome is especially beneficial in developing countries like India, where penetration of specialized ophthalmic care is insufficient.

Considering limited resources and an overburdened healthcare system, these kinds of solutions help reduce the screening burden on healthcare specialists and focus key resources on patients who need immediate care and intervention. It also reduces the time and cost of the patient spent on screening visits to tertiary eye care. The solution helps to correctly classify normal versus abnormal images with very high accuracy. It also helps in identifying patients who don't need further treatment in the hospital, thus avoiding unnecessary travel and saving time for those patients who do not need DR follow-up care.

Looking Ahead to the Future

Building on this implementation, Sankara Eye Foundation India plans to use more advanced AI tools on Intel processors for region-specific scaling, adhering to local healthcare regulations. Sankara Eye Foundation India looks forward to forging an even stronger collaboration with Intel to further optimize the solution, scale up efforts and to make the capabilities available through strong collaborations with ecosystems like AWS, and more.

Where to Get More Information

Find the solution that's just right for your organization. Contact your Intel representative or visit intel.com/ai



¹Source: https://www.eurekalert.org/pub_releases/2018-11/tl-tld111918.php

²Source: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7003578/>

³Source: <https://analyticsindiamag.com/how-sankara-eye-hospital-is-using-ai-for-diabetic-retinopathy-detection/>

⁴Source: <https://www.ijo.in/article.asp?issn=0301-4738;year=2020;volume=68;issue=2;spage=398;epage=405;aulast=Shah>

⁵Source: Leben Care

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