Case Study

Healthcare
Intel® Xeon® Scalable Processors
Intel® Core™ Processors
Intel® Distribution of OpenVINO™ Toolkit
Intel® OpenFL

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Improving Early-stage Cancer Detection Rates with Federated Learning

JelloX Biotech Inc., QMed Asia and Intel Malaysia collaborated on an innovative federated learning solution that is driving the digital transformation of healthcare in Malaysia and helping save lives.

"In the collaborative effort between Qmed and JelloX, Intel played a pivotal role. Initially, they introduced us to JelloX, fostering a substantial collaboration that enabled us to introduce these solutions to key markets. Furthermore, the utilization of Intel's advanced chipset and computing power was instrumental, facilitating the processing of extensive datasets and enabling us to conduct interpretations using the discounted advanced chipset power provided by Intel."

—Dr. Kev Lim – Co-Founder & CEO, Qmed Asia

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Malaysia is known for its dual-tiered healthcare system. This system, led by the government and the private sector, offers a unique blend of universal coverage and diverse, choice-driven healthcare services. Despite this level of coverage, Malaysia still grapples with a pressing healthcare challenge—low rates of detection of cancer. Startling statistics reveal that over 63% of cancer diagnoses in Malaysia are made at advanced stages, severely limiting treatment options and significantly increasing healthcare costs. The most prevalent cancers—cervical cancer, colorectal cancer, and lung cancer—underscore the critical need for innovative solutions to revolutionize the diagnostic landscape. This multi-faceted issue necessitates a fundamental shift in healthcare delivery methodologies and patient awareness.

Recognizing the urgency of this matter, QMed Asia, Malaysia's leading online doctor consultation platform collaborated with JelloX Biotech Inc. from Taiwan to innovate a federated learning (FL) solution that would digitally transform 3D diagnostics in Malaysia. Intel was sought out as a technology partner for its expertise in providing hardware and software for AI, ML and Computer Vision-based solutions to enable similar biomedical use cases.

Pioneering Malaysia's Digital Healthcare Transformation

Malaysia grapples with a stark reality in cancer diagnostics — a screening coverage of 25%[1] for cervical cancer and an early diagnosis rate of 10%[2] for lung cancer. These figures stand in stark contrast to the 70% screening rate and 40% early diagnosis average in more developed countries. The reasons behind this disparity are deeply intertwined with the healthcare landscape and decision-making in Malaysia, and reflect the challenges faced by digital transformation initiatives worldwide:

Negative Mindset and Trust Deficiency:

A prevailing negative mindset towards screening, detection and the combined cost implications serve as a barrier to early detection. Coupled with a lack of trust in the healthcare system, this makes cancer diagnosis challenging.

Inconvenience in Early-Stage Procedures:

Due to the growing number of cases and the subsequent constraints on medical infrastructure, seeking during the early stages of cancer proves inconvenient. This can lead to delayed detection, limited treatment options and negative treatment outcomes for those battling cancer.

Outdated and Inefficient Workflows:

The existing diagnostic workflows suffer from inefficiencies and outdated practices. Imaging reports, slides and medical records are often stored offline or in physical formats. This hinders their accessibility and sharability among medical professionals. The result is often inaccurate or misdiagnosis which can reduce the probability of a positive treatment outcome.

High Cost of Diagnosis and Screening:

Lastly, the financial burden associated with cancer diagnosis and screening further exacerbates the challenge, creating a vicious cycle of misdiagnosis and missed opportunities for the right treatment, especially targeted therapies.

To be truly effective, the digital transformation of 3D diagnostic and early screening systems would need to address these challenges.

MetaLite®: JelloX and QMed Asia's Transformative Response

MetaLite® is a federated learning (FL) solution developed by JelloX Biotech Inc. to optimize cancer diagnostics and screening. It incorporates QMed Asia's solution architecture with JelloX's 3D medical imaging technology and is strongly supported by Intel's platforms and tools.

In a nutshell, the solution allows for the digitization of medical imaging records such as chest X-rays and pathology slides from pap smears. The whole process starts with scanning tissue samples on glass slides with a high-resolution digitizer. All big data images are stored and processed in a high-performance computation server. These digitized images undergo visualization by MetaLite® platform with plug-in AI functions, and AI inference to help clinicians and medical professionals make accurate diagnoses of cervical and lung cancer. What truly sets the system apart, however, is the MetaLite® Federated Learning Interface, which allows the solution to analyze and process medical data in a decentralized manner across multiple sites.

The solution has been currently deployed across two major hospitals in Malaysia, Hospital Universiti Malaysia Sabah (HUMS) in Sabah, Malaysia for the screening and detection of cervical cancer and the World Trade Center MediClinic (WTC MediClinic) in Kuala Lumpur. The solution allows for the sharing of imaging and inferencing data between both these centers.
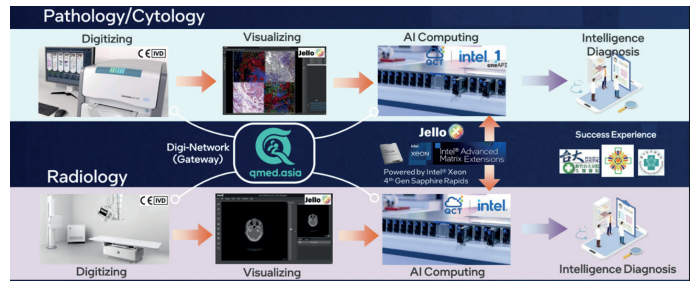

Figure 1: Workflows for the detection of cervical and lung cancer using the MetaLite® solution

Key Advantages of the MetaLite® Digital Pathology Edge Solution

With an edge device-based design and a plug-and-play operation, MetaLite® ensures that scalability doesn't equate to complexity, providing healthcare institutions with a solution that effortlessly grows with their evolving needs in an easy-to-move and easy-to-implement manner.

The no-code operation and straightforward workflow of MetaLite® contribute to its user-friendly interface, eliminating barriers and making it accessible to a broad spectrum of healthcare professionals. This simplicity in operation extends to the MetaLite® Federated Learning (FL) interface, creating a codeless workflow that streamlines tasks. This not only enhances user experience but also accelerates the integration of the solution into existing healthcare frameworks.

A critical advantage of MetaLite® is its commitment to safeguarding patient privacy through robust cybersecurity measures. Protected by Intel® SGX, MetaLite® ensures a "zero-trust" environment, instilling confidence in both healthcare providers and patients. The FL interface further fortifies this cybersecurity posture, offering an efficient and cost-effective alternative to traditional data transfer methods.

The medical data-optimized pre-processing capabilities of MetaLite® play a pivotal role in elevating the quality of diagnostic insights. By ensuring uniformity in models, secure data collection, and optimized preprocessing of medical data, MetaLite® stands at the forefront of precision and efficiency in cancer diagnostics. This comprehensive suite of advantages positions MetaLite® as a transformative force in digital pathology, offering a user-centric, secure, and highly efficient solution for healthcare institutions across Malaysia and beyond.

The Federated Learning (FL) Interface, a pivotal component of MetaLite®, disrupts the conventional diagnostic approach. By ensuring model uniformity, secure data collection, and optimized medical data preprocessing, the MetaLite® Federated Learning (FL) Interface acts as a catalyst in breaking the cycle of delayed cancer diagnosis.

Advantages of Federated Learning:

Codeless Operation Workflow: The FL interface brings a paradigm shift with a codeless operation workflow, simplifying diagnostic procedures and making them more accessible to different sites.

Cyber Security Protection: The integration of federated learning ensures robust cybersecurity protection, a crucial factor in handling sensitive medical data.

Option of Aggregation vs. Data Transfer: MetaLite® offers a flexible solution by providing the option of aggregation vs. data transfer. This approach proves to be both efficient and cost-effective, overcoming limitations associated with traditional infrastructure.

Intel: Delivering Hardware and Software Support To This Novel Solution

In the realm of AI-driven healthcare solutions, Intel plays a key role in making this collaboration a success. The choice of Intel as the preferred partner is rooted in the intrinsic capabilities of Intel® Xeon® Scalable Processors and Intel® Core™ processors, complemented by the optimization prowess of Intel® Distribution of OpenVINO™ Toolkit.

Intel's hardware and software components distinguish themselves as the optimal choice for AI workloads, giving the MetaLite® solution a strong foundation for computational efficiency. The hardware (Intel® Xeon® Scalable- and Intel® Core™ processors) used in the solution is purpose-built for AI acceleration and to deliver unparalleled performance and scalability. Similarly, on the software front, Intel® Distribution of OpenVINO™ toolkit is tailored for high-performance computer vision and significantly enhances the diagnostic capabilities of MetaLite®.

Faster Inference For Early Detection: Intel® Distribution of OpenVINO™ Toolkit

The selection of the Intel® Distribution of OpenVINO™ Toolkit , leveraging the FP32 format, stems from its remarkable performance. Comparative analysis showcased a remarkable 5x improvement[3] in inference performance compared to TensorFlow C API, underscoring the toolkit's pivotal role in enhancing the MetaLite® solution's efficiency.

Intel® Distribution of OpenVINO™ toolkit played a pivotal role in optimizing the federated learning algorithm, significantly boosting inference performance on Intel® platforms. JelloX's design team harnessed the toolkit's Model Optimizer to convert formats and optimize images using framework-agnostic transformation techniques. This included constant folding, batch norm fusing, and pad fusion, collectively contributing to the precision of MetaLite®'s image processing and inference at scale.

Intel® Xeon® Processors: Enhancing MetaLite®'s Processing Power

4th Gen Intel® Xeon® Scalable Processors used in this solution feature cutting-edge microarchitecture and Intel® Advanced Matrix Extensions (Intel® AMX). This built-in AI accelerator supports the quantization of models to the brain floating 16 (bfloat16 or bf16) numeric data type, enhancing the speed and efficiency of AI workloads. Intel® Distribution of OpenVINO™ toolkit complements this architecture, employing varying graph optimization techniques to further amplify AI performance. The result is significantly faster AI inference in medical imaging, marking a breakthrough in diagnostic efficiency.

Intel®OpenFL and Intel® SGX: Safeguarding Patient Privacy with Federated Learning

Intel® Open Federated Learning (Intel® OpenFL) is a Python* 3 library framework designed to be flexible, extensible, and secure. This framework allows organizations to engage in collaborative multiparty machine learning without compromising the confidentiality of their data. Unlike traditional approaches, Intel® OpenFL processes data on-premises using Intel Software Guard Extensions (Intel® SGX).

At the chip level, Intel® SGX creates a Trusted Execution Environment (TEE) that safeguards both the intellectual property of algorithms and the privacy of patients' healthcare data. This combination of hardware and software provides a robust federated learning ecosystem for the Metalite® solution allowing it to aggregate de-identified results centrally without exposing any party's confidential data to others. This level of confidential computing reinforces all the stakeholders' commitment to maintaining the highest standards of security and confidentiality in healthcare diagnostics.

The Results: Efficiency and Cost Optimization In 3D Imaging Workflows

The impact of MetaLite® on healthcare workflows is both quantifiable and groundbreaking. Through meticulous deployment, the solution has achieved a remarkable 20% increase in the efficiency of diagnostic workflows, a 50% reduction in diagnostic costs, streamlining processes and reducing the time from imaging to diagnosis. This not only expedites patient care but also plays a pivotal role in addressing the challenges associated with late-stage cancer diagnoses.

Furthermore, the financial implications of MetaLite® are nothing short of transformative. The solution has delivered significant cost savings in the domain of imaging and diagnoses, underscoring its economic viability for digital healthcare in Malaysia.

The impact of MetaLite® on healthcare workflows extends beyond efficiency gains and cost reductions, making a significant contribution to Malaysia's early screening

programs for cervical cancer. By integrating seamlessly into these programs, MetaLite® not only expedites diagnostic workflows, reducing the time from imaging to diagnosis and streamlining processes but also contributes to the scalability of early screening initiatives. This strategic integration is poised to save considerable manpower and man-hours, ensuring a more widespread and efficient reach of these solutions. MetaLite's® role in Malaysia's early screening programs represents a paradigm shift, leveraging technology to address the challenges associated with late-stage cancer diagnoses while optimizing resources for more extensive and impactful healthcare interventions.

Ushering In A New Era In Digital Healthcare and Diagnostics

Since Malaysia lies at the heart of Southeast Asia, the success of this solution has widespread implications for the digital transformation of healthcare in the entire subregion. The strides made in improving diagnostic workflows, reducing costs, and seamlessly integrating into early screening programs for cervical cancer mark a significant leap forward in the landscape of healthcare technology.

MetaLite®'s success in Malaysia not only addresses the immediate challenges faced by the healthcare system but also sets the stage for a more interconnected and technology-driven approach to healthcare in Southeast Asia. With the approval from the Taiwan Food and Drug Administration (TFDA), MetaLite® is poised for a broader regional deployment, promising to revolutionize healthcare diagnostics across borders. The collaborative efforts of JelloX Biotech Inc. and Intel have not only elevated healthcare efficiency in Malaysia but have sown the seeds for a new era of digital healthcare in the entire Southeast Asian region.

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