Smarter Imaging

Optimizing Dermatology Screening with AI Model Integration

Using a mix of high-level tech design, solution architecture, project management principles, and technical marketing expertise, Liminal Labs successfully integrated and scaled a new AI model with a medical imaging manufacturer's existing hardware and software image capture platform, leading to faster scan rates, increased operational efficiency, and new sales opportunities.

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The Client:

- **Industry**: Medical Imaging
- **Project Duration:** 9 months
- **Services Used:** AWS (Elastic Container Service, VPC, IAM, S3, SQS, RDS, SageMaker), GitHub Actions, New Relic
- **Languages / Frameworks:** C# .NET, Python, Javascript, OpenCV, Keras, Terraform
- **Domains:** Computer Vision, Cloud-Native Services, Web Application Development

Background:

Artificial intelligence (AI) is revolutionizing medical imaging with deep learning algorithms to identify abnormalities and diseases more quickly and precisely than ever before. These advances are especially significant in dermatology, where AI capabilities can aid medical researchers and healthcare providers in the early detection and prevention of skin cancers and abnormalities.

Liminal's client, a hardware manufacturer in the medical-imaging space, provides a unique 360-degree machine that produces high-resolution, '"real life'" images and videos with an easy-to-use interface. With an established customer base in the aesthetics industry, the client expanded into dermatology. They contracted a third-party AI vendor to develop a deep learning algorithm for early detection of melanoma.

Integrating AI with the existing product had several positive implications. The AI-enabled imaging machine could allow primary care practices to screen for skin abnormalities, track and detect melanoma, and perform long-term observational care in-house, eliminating the need for a separate dermatology visit and boosting the availability of dermatology screening in remote areas. The enhanced product, which is more effective than self-assessment via mobile applications, would also allow medical researchers to examine disease progression through multiple patient visits and image monitoring.

The Challenge:

The AI model, as received from the third-party vendor, was mostly functional but required significant refinements to integrate into the client's existing hardware and software at scale.

The model's server failed intermittently and gave inconsistent results, creating a critical blocker for commercial viability. Potential security risks were also identified, as the current server did not support SSL or authentication. The server also needed to be reconfigured to comply with HIPAA and HITECH regulations in a clinical setting.

Scaling the product to meet customer demand would require significant enhancements to the client's technology infrastructure. Each scan required 500MB of data to generate and store an image and the images needed to be displayed in a web browser within 1-2 minutes. The system also needed to support hundreds of machines simultaneously, all executing hundreds of concurrent requests—an exponential increase from the vendor-developed AI model which could only handle a maximum of two concurrent requests.

Workforce management was another key consideration of the project, as the client was operating with a lean team spanning five time zones, with no product owners, UX designers, or project managers on staff. Team members also lacked prior experience with the new platform and would have to undergo additional training.

The Solution:

Liminal's approach centered on optimizing the current technology infrastructure, streamlining operational efficiency, and improving overall quality, security, and compliance.

Solution Architecture

The Liminal team began by assessing the existing infrastructure, opting to retain the existing MySQL system to store scan results while emphasizing compatibility with the previous domain-driven boundaries. In addition, a new user interface for starting scans and presenting results was developed within the client's existing design system.

Addressing security risks and safeguarding patient data was a top priority. Liminal implemented service-to-service authentication and private virtual networking via AWS VPC, which secured the connection between the service worker and the AI model server. AWS S3 was also configured to leverage encryption-at-rest and IAM-based policy access. These enhancements not only accommodated high scalability, but also met HIPAA and HITECH security requirements.

Project Management

For the project to succeed, the client's highly distributed team needed a system to improve collaboration. Using a two-week Agile project development cycle, Liminal implemented issue tracking in Jira and facilitated Scrum-based kickoff, stand-ups, backlog refinement, and review meetings to ensure team members remained engaged and on track.

Liminal's team provided training to the engineers from the client's externally hired software staffing vendor, and documented workflows using interface design tool Figma and a Confluence workspace. The team also assisted the client with building,

configuring, and deploying C# projects to the client's existing AWS architecture and its Windows-based image capture devices.

With the client's executive leadership, Liminal identified an overuse of resources in non-critical areas, which significantly impacted the project budget and monthly burn rate. Liminal advised the client on how to best reconfigure its resources, retaining high-performing contributors and augmenting its staff with Liminal team members as well as freelance partners at a more sustainable long-term cost.

Quality Assurance

Liminal implemented several improvements that addressed quality concerns as well as improved the end-user experience. The team introduced a resilience mechanism that allowed the backend to retry failed scans while ensuring stability for the end user. Liminal also assisted the client in cataloging, analyzing, and prioritizing errors, allowing for more effective troubleshooting and quality control.

Lastly, through collaboration with the AI model's original vendor, and leveraging relationships with academic research departments across leading U.S. institutions, Liminal anticipated and resolved issues before they negatively impacted the rollout.

Technical Marketing

With the AI model integration underway, it was time to share the excitement. Liminal researched and contributed to a new white paper highlighting the challenges researchers and primary care providers face when improving early melanoma detection. Additionally, the paper underscored the advantages and potential of the client's AI-powered capture platform.

Well-received by universities, hospitals, and cancer research centers, the publication led to deeper partnerships and discussions between the client and potential customers.

The Results:

Following the successful integration of the AI model, the client was able to support 50 concurrent scan requests, achieving an average scan time of two minutes under peak load. Efficient reallocation of development resources also allowed the client to reduce their monthly engineering spend by 40%, with no negative impacts observed.

In Q2 2024, the client held a successful demo of the product UI at a major trade show, which sparked interest in sales among dermatologists. Due to high demand, the client is expected to deliver the product to production in Q4 2024.

Our Core Capabilities:

At Liminal Labs, we build scalable software solutions for life sciences and social impact organizations, focusing on Solution Architecture, Cloud Infrastructure, and Full Stack Development. We help advance precision medicine, bioinformatics, and medical imaging while ensuring security, compliance, and seamless integration so your software grows with you.

Solution Architecture

We deliver robust, secure designs tailored to life sciences and healthcare, maintaining the highest standards of scalability and compliance.

- Authorization / SSO
- Third-Party Integrations
- Model as a Service (MaaS)
- Data Privacy, Security, and Retention

Cloud Infrastructure

We provide cloud infrastructure solutions for life sciences, ensuring secure, resilient, and efficient operations. Our expertise enables life sciences organizations to stay focused on their core objectives.

- Azure, AWS, GCP, Docker / Kubernetes
- Deployment Pipelines
- Autoscaling and Load Balancing
- Backups and Disaster Recovery
- Identity and Access Management

Full Stack Development

Our high-performance application solutions feature responsive dashboards, data visualizations, and instrument control interfaces.

- Custom software
- Instrument UIs
- Data visualizations
- Dashboards and file browsers
- Enterprise apps

Get in Touch

Want to learn more? Contact us for a free consultation and start your project with Liminal Labs. connect@liminal.sh