AI in Healthcare

Monitoring face mask usage in healthcare settings

A flexible approach for face mask compliance at point of ingress

■ NetApp

The COVID-19 pandemic has resulted in significant transmission risks in public spaces with high densities of pedestrian traffic. Use of face masks and adequate social distancing are essential in hospitals and congregate living spaces such as assisted living facilities and nursing homes. Proper masking is critical in clinical settings where distancing isn't always practical, especially when rates of infection are high. Many healthcare facilities monitor and enforce masking for employees and patients at entrance and exit points.

Video cameras are common in public healthcare spaces, creating an opportunity to combine existing video feeds with AI and computer vision to monitor compliance with masking and other guidelines to minimize risks nonintrusively. Many institutions have video systems but don't have much, if any, automation associated with monitoring video feeds, limiting the value of those investments.

Putting face mask detection to use

An AI model for face mask detection can be applied in various ways to address compliance requirements. For example, you can monitor public and private entryways to passively assess patients and staff entering each facility. Many facilities continue to dedicate staff to monitor entry doors, a practice that might be unnecessary where compliance is high. However, as the percentage of the population that's vaccinated continues to increase, new problems can emerge.

Although we haven't yet implemented the capability, it should be possible to enhance an AI solution to deny entry to a facility or a particular area to anyone who isn't properly masked. For example, AWS SageMaker Neo can be used to deploy AI models on edge devices so that doors don't open unless entrants are properly masked.

For this system to work, object detection and localization must occur in near real time, requiring inferencing at typical video frame rates. NetApp and SFL Scientific have implemented a flexible technology stack to meet the diverse requirements of healthcare institutions. Depending on your IT and organizational needs, our solution can be implemented on premises through purchase or subscription, or in the cloud through subscription.

Optimizing the management of video data

The combination of AI and video creates significant data management challenges, both during training and inferencing. The challenge in training consists of creating a deep learning model optimized for your environment. For inferencing, the challenges lies in applying the resulting model to video data. Together, NetApp and SFL Scientific offer the tools and expertise necessary to deliver an optimized solution for data management during all phases of the data and machine learning lifecycles.

Efficient training

In a typical training effort, SFL data scientists experiment with AI model configurations and data transformation methods, using multiple model tuning experiments to maximize performance and accuracy. After they select the model that performs best, they might retrain it at regular intervals by using recent video samples to minimize errors, increase accuracy, and reduce bias. For example, several mask styles are typically in use in any facility, and styles can change when new personal protective equipment (PPE) arrives. Mask styles for personal use have been evolving steadily throughout the pandemic, and some patient masks might be deemed unacceptable. Other facilities require that patients and staff wear only masks that are approved and supplied by the facility. Retraining keeps a model performing well on mask detection tasks, even as transitions like these occur.

During experimentation and retraining, efficient data management and traceability are a significant part of the total effort. It becomes essential to have the right tools to construct unified data pipelines that incorporate different data sources and move and manage data quickly and efficiently.

The NetApp® AI Control Plane pairs machine learning operations (MLOps) tools with NetApp technologies for data storage, movement, and replication to simplify the management of AI data and facilitate experimentation. The NetApp Data Science Toolkit makes it easier to manage the large volumes of data required for training deep learning models. Whether your project is on premises or in the cloud, using these tools, we can quickly set up and clone volumes for training. We can also perform experiments, evaluate results, and iterate quickly with full traceability so that you get reproducibility, reliability, and compliance.

Removing bottlenecks during inference

A busy healthcare facility might have multiple ingress points with near-constant activity. Analyzing this data can require substantial storage capacity and bandwidth as well as significant compute resources.

Our on-premises mask compliance solution benefits from the robust data pipeline and parallel processing capability of NetApp ONTAP® AI software, consolidating a data center's worth of analytics, training, and inferencing power into a single system. From preprocessing to feeding data to neural

networks to model training and retraining, ONTAP AI removes performance bottlenecks and accelerates AI workloads. ONTAP AI keeps up with inferencing tasks while also enabling data scientists and data engineers to accomplish more work in less time.

If your on-premises video surveillance systems are due for an upgrade, NetApp Video Surveillance Storage (VSS) solutions are built using fast, reliable, and cost-effective NetApp E-Series storage. The storage interfaces directly with the NVIDIA DGX computing systems used by NetApp AI and other high-performance hardware.

Cloud-based mask compliance uses NetApp Cloud Volumes ONTAP, NetApp's cloud data management solution. Cloud Volumes ONTAP optimizes cloud storage costs and performance while enhancing data protection, security, and compliance. If your operations require both on-premises and cloud elements, NetApp ONTAP solutions simplify data movement and management in hybrid environments.

Data tiering and archiving

Video data and inference results often need to be stored for extended periods. NetApp simplifies the process of tiering cold data to less-expensive storage. NetApp FabricPool can automatically tier cold data to object storage such as Amazon Simple Storage Service (Amazon S3) and retrieve it without operator intervention. If you prefer to keep all data on premises, NetApp StorageGRID® provides large-scale object storage that works with FabricPool or as a standalone product.
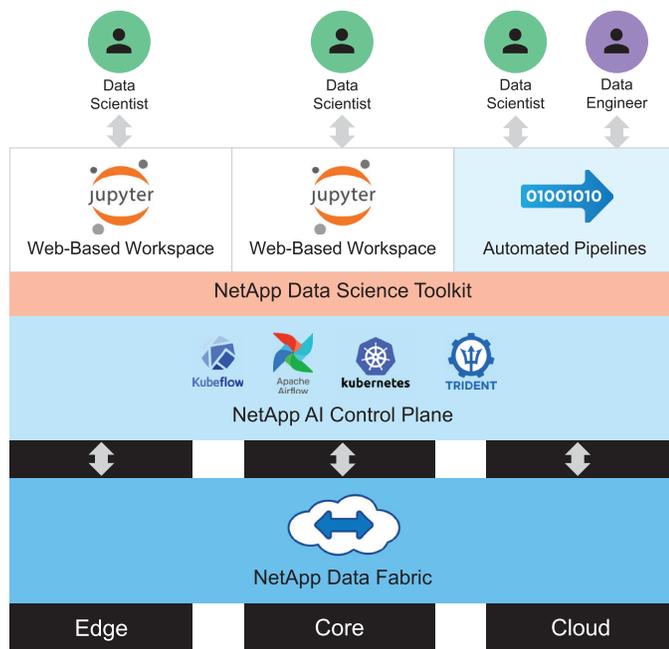

Figure 1) The NetApp Data Science Toolkit and AI Control Plane integrate intelligent data management into data science workflows, eliminating complexity and wasted time.

A flexible approach to mask compliance

Many object detection models can localize and detect faces. Models need to be properly trained using datasets that have adequate minority representation to minimize bias and eliminate errors. With this training, these models provide a significant head start for mask detection, such that our solution needs to determine only whether a detected face is properly masked.

We use these AI models only to detect faces, not to identify people or classify them based on demographic attributes. Our solution focuses on efficient mask detection that fits easily into compliance workflows and that can operate at scale either on premises or in the cloud.
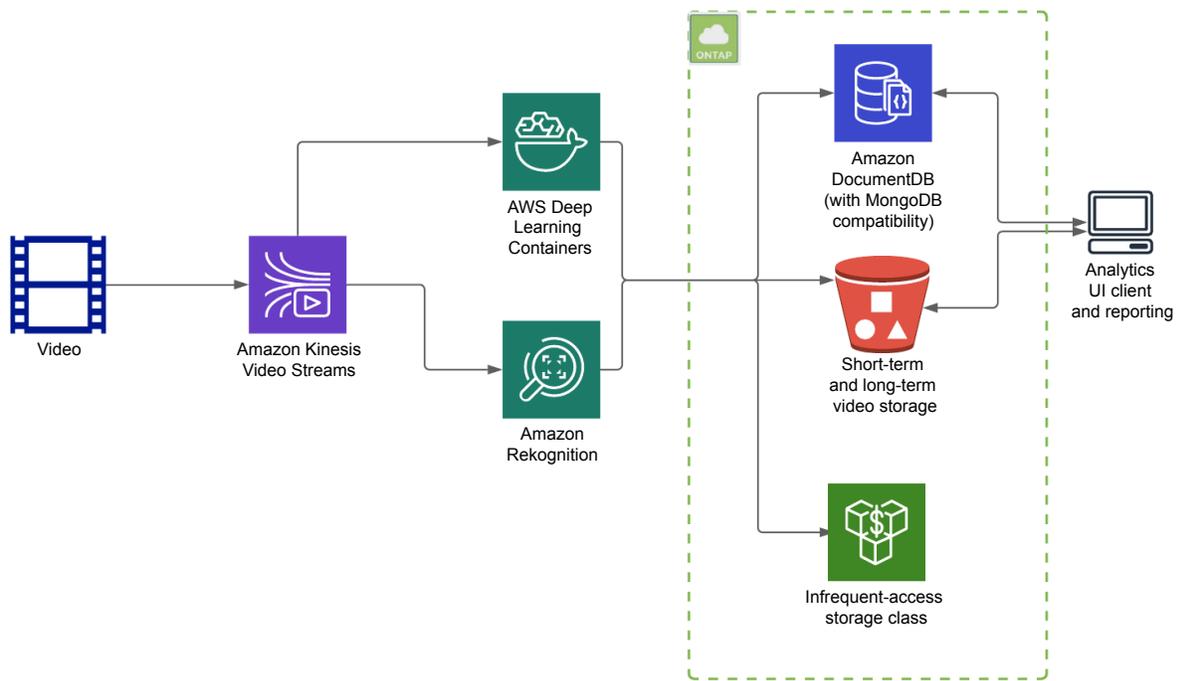
Figure 2) Our AWS workflow uses capabilities provided by Amazon Kinesis, Rekognition, and Deep Learning Containers to create a streamlined and flexible cloud solution.

Our customized AI models perform mask detection assessments on video from ingress and egress points. With the interactive UI, you can review the video feeds with mask detection overlays, or drill down into more detailed analytics to determine levels of adherence to mask-wearing policies. Reporting, anomaly detection, and interactive analysis workflows allow you to distill and communicate actionable insights based on observed behavior.

On-premises mask detection

For on-premises detection, the solution runs in your data center, integrating with on-premises video surveillance systems to analyze video streams for mask compliance. NetApp and SFL Scientific have developed a technology stack that results in high performance and accuracy for mask detection by using a preexisting model and transfer learning. NVIDIA has previously outlined a developer recipe for implementing face mask detection with NVIDIA Clara Guardian. Adopting this approach enables us to streamline the development, training, and delivery of AI

models for on-premises mask detection. This methodology produces an accurate, trained model in a short time and supports ongoing training and optimization with complete traceability.

In-the-cloud mask detection

Our cloud approach is well suited to sites that already store or archive video surveillance data in the Amazon cloud. We prototyped our cloud implementation on AWS by using Amazon Kinesis Video Streams and Amazon Rekognition. Kinesis interacts with Rekognition to tag your video with object detection metadata. Rekognition offers the built-in ability to detect faces and track the path of people in a video for social distancing studies, storing detected facial information in collections. **Note that Rekognition is not used to identify people in this implementation**.

Using AWS Deep Learning Containers, we created a model to identify masks on the faces detected by Rekognition. The video itself, the number of people detected, the objects detected, and other features are stored for later review and analysis.

More compliance solutions

Our methodology for face mask compliance can be readily adapted to other compliance needs in healthcare and beyond. For example, hand washing is critical for infection control, especially in areas such as ICUs, isolation wards, and operating rooms. A targeted solution could monitor hand-washing compliance in these areas.

Drug wastage and mishandling is another important challenge that many facilities face. An unobtrusive video compliance solution might help hospital pharmacies adhere to proper procedures or identify places where drugs are handled improperly.

About our partnership

The partnership between NetApp and SFL Scientific brings together SFL's proven data science and data engineering expertise and NetApp's industry-leading AI hardware and software.

Getting started

To find out whether NetApp and SFL Scientific can help you accelerate your path to AI, visit netapp.com/ai and fill out the form to request a contact.

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Overcoming the challenges of building an AI architecture for machine learning (ML), deep learning (DL), and other AI workflows requires careful infrastructure planning. NetApp helps customers build AI pipelines that smooth the flow of data and deliver optimal results.

NetApp offers a complete portfolio of AI hardware and software solutions to get your data flowing from edge to core to cloud. netapp.com/ai

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