SOLUTION BRIEF

Intel® Vision Products
AI Solutions for Manufacturing and Smart Cities

ADLINK and Touch Cloud Deliver AI Solutions Powered by Intel® Vision Products

AI catalyzes operational improvements for manufacturing and smart cities

"ADLINK is committed to bringing AI to the edge. We are taking a heterogeneous computing approach to AI deployments and building the right solution for our customer based on their computing needs. Using Intel® Vision Accelerator Design products with Intel® Movidius™ VPUs and the OpenVINO™ toolkit, Adlink's AI platforms can speed up image processing, computer vision, and deep learning inferencing with power efficiency not yet fully recognized in the market. With these advantages, ADLINK can better target edge applications and infuse the power of AI in vertical markets including manufacturing, transportation, healthcare, retail, smart city, and more. Specifically, by leveraging the OpenVINO™ toolkit we saw more than an 11x increase in performance[1] on the CPU vs. running without the OpenVINO™ toolkit. Even more compelling is the 19x performance increase[2] we saw when we added our own EDL-mPCIe-MA2485*, a mini-PCIe* accelerator card based on the Intel® Vision Accelerator Design."

—Edgar Chen, general manager, Embedded Platforms and Modules, ADLINK Technology

Executive summary

Video data is informing the next era of IoT, but aggregating, filtering, indexing, and classifying this data in near-real time requires advanced vision capabilities and technologies. Together, ADLINK, Touch Cloud, and Intel provide a turnkey AI engine to assist in data analytics, detection, classification, and prediction for a wide range of use cases. Smart city and manufacturing operations are prime examples of both the complexity and opportunities enabled by the convergence of vision capabilities, IoT, and AI solutions.

Challenges

Manufacturing facilities and smart cities share many of the features that make deploying IoT challenging across vertical sectors—from the complexity of gathering relevant, coherent data from a plethora of equipment, systems, devices, workflows, and facilities to cost-effectively filtering data for analysis at the edge or in the cloud to utilizing the resulting insight to take action in near-real time. Whether trying to evaluate operations across multiple factories or coordinate responses across diverse agencies, manufacturers and city planners require a holistic, accurate, and continual view of operations.

Industrial automation is a key facet of global manufacturing, with enterprises facing competitive pressures to maximize output while lowering costs. Factory operations are time sensitive and low latency is critical, as is achieving the right balance of power consumption and performance. Investments in legacy infrastructure, proprietary equipment that is not designed for compatibility, and the merger of OT and IT add to the complexity of implementing a cost-effective and manageable solution that meets compliance and deterministic requirements.

Likewise, today's cities must align a vast network of services, providers, agencies, equipment, and infrastructure in order to improve quality of life and increase efficiency. Legacy city systems are often decades old and unsuitable for rapidly increasing urban populations. Cities require timely, accurate data to ensure essential capabilities run without disruption, including emergency responders, police and fire departments, transit services, and utilities.

Video data offers valuable insight, but access to streaming video is only the beginning. In order to be relevant, and timely and inform strategy, video data must be accessible in near-real time, indexed, classified, and searchable.

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Touch Cloud Inc.

Because this data also brings significant bandwidth demands, it also must be filtered for cost-effective transmission and actionable intelligence at the edge.

While AI unlocks the insight to address these challenges, no single solution can satisfy all applications.

Solution

Intel, ADLINK, and Touch Cloud are working together to bring inference acceleration to a wide range of industrial and commercial technologies.

In the integrated AI solution, ADLINK provides the optimized hardware platform and connectivity; Touch Cloud, the software application and analytics; and Intel, the IoT gateway processor, Intel® FPGA, and Intel® Movidius™ Myriad™ X vision processing unit (VPU), as well as the OpenVINO™ toolkit for smart vision application development. The end result allows implementation of AI and leverages legacy infrastructure, while achieving the benefits of IoT.

To enable AI and seamless integration with an Intel® architecture-based gateway at the edge, ADLINK's MXE-210*—with its compact size, wide operating temperature range, and EMC-certified protection—can be easily installed in space-confined environments for reliable 24/7 operation. WLAN/WWAN support makes it possible for MXE-210 to communicate with back-end servers.

Intel® Vision Accelerator Design with Intel® Movidius™ VPU

Intel Vision Accelerator Designs with Intel® Movidius™ VPUs provide power-efficient deep neural network inference for fast, accurate video analytics. These accelerators are capable of operating on customizable complex networks and network layers with high compute and ultra-low power consumption, resulting in industry-leading performance/watt/$.

These VPUs support ecosystem solutions for high-quality image processing, computer vision, and deep neural networks. They drive a demanding mix of vision-centric tasks in modern smart devices. AI solutions can scale simply by adding Intel Vision Accelerator Designs with Intel Movidius VPUs, while still retaining their core efficiency. The elegant balance of performance and efficiency enables deployment for well-defined deep learning and machine vision workloads. Highly parallel programmable compute is co-located on a common intelligent memory fabric with workload-specific hardware acceleration.

ADLINK is currently utilizing Intel Vision Products for multiple AI solutions, and is working closely with Intel to ensure that the next generation of its deep learning accelerators and inference platforms leverage the power of the new Intel Vision Accelerator Design with Intel Movidius VPU. This accelerator design is expected to bring significant increases in the performance and processing of video data.

Addressing critical use cases

Touch Cloud AI models running on ADLINK's edge computing platforms powered by Intel architecture bring near-real-time analysis, indexing, and search to streaming video to support a breadth of IoT use cases.

Manufacturing

AI-enabled machine vision is addressing scenarios that cannot be tackled with rule-based machine vision. Solutions from ADLINK and Touch Cloud, powered by Intel® Vision Products, are able to mimic the human eye and brain, for instance, detecting manufacturing defects in hard-to-discern materials such as solar panels, textiles, wood, or food at high levels of accuracy for better quality assurance.

Automatic meter reading (AMR)

Unconnected meters are often inspected manually, requiring time-consuming and costly data collection. With the ADLINK MXE-210* inference platform and cameras at the edge, meters for industrial gas, oil, and other fluids can be read automatically. By sending the data to the back-end servers over wireless or wired networks, MXE-210 enables near-real-time remote monitoring of automated processes and industrial utilities, including water, electricity, and gas consumption.

AMR is ideal for use in oil and gas, petrochemical, water treatment, pharmaceutical, and food and beverage industries.

Meters

Cameras capture meter images and send them to the MXE-210.

MXE-210 with Intel® Movidius™ Myriad™ X VPU acts as an inference platform to identify the reading.

MXE-210 also serves as a gateway, sending the reading to back-end servers for data acquisition and near-real-time monitoring.

The meters can be monitored remotely.

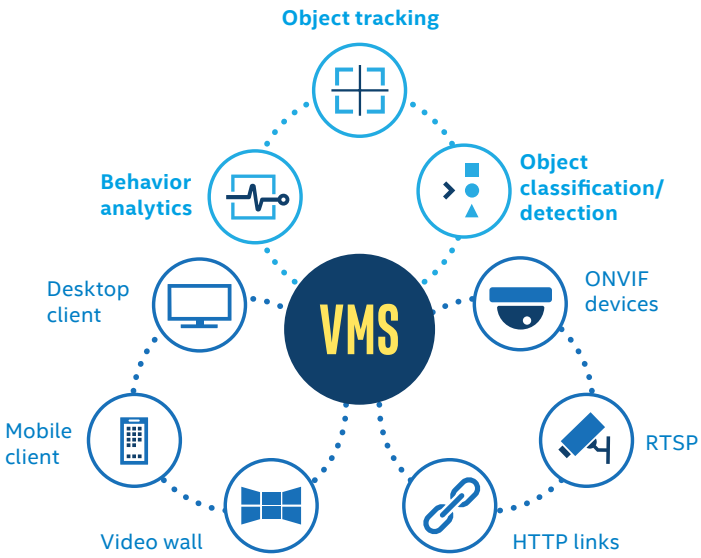
Automated meter reading for manufacturing integrates AI for fast, accurate inspection

Image classification and segmentation

The AI solution leverages algorithms developed using the OpenVINO toolkit to classify images into predefined categories. In order to simplify and/or change the representation of an image into something that is more meaningful and easier to understand, image segmentation divides images into segments or regions belonging to the same class and category.

Automated optical inspection (AOI)

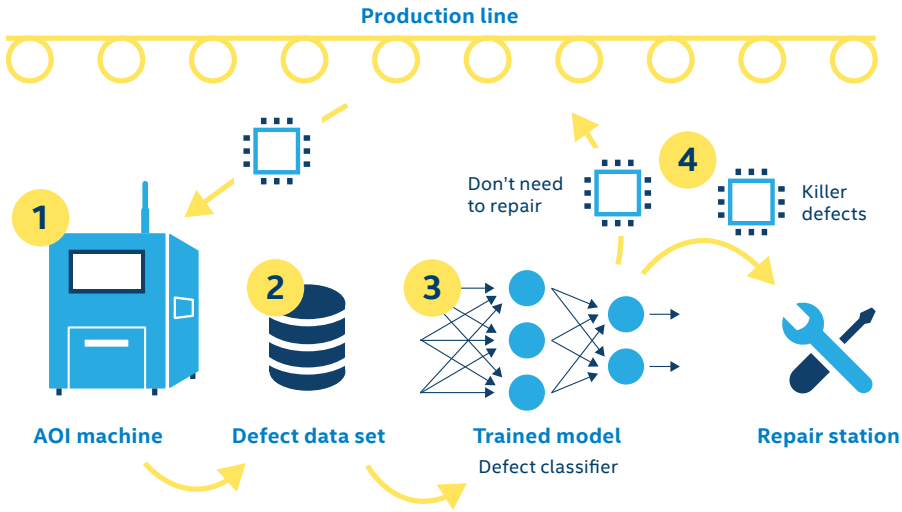
During the manufacturing process, defects that harm product yield and quality need to be detected and classified to protect production quality and reduce the cost of rework. AOI automates visual inspection of product manufacture (e.g., PCB, LCD, or transistor) via a camera that autonomously scans the device under test for quality defects, such as fillet size or shape or component skew. With ADLINK's high-performance expandable edge computing platforms, the solution improves near-real-time defect detection and identification of AOI machines and augments the defect classification capability with domain knowledge learned using AI.



Complex image classification and segmentation support fast indexing and searching of visual data streams

Defect classification

During the manufacturing process, defects can be introduced that impact product quality. It is necessary to classify the defects detected by AOI appropriately—the higher accuracy in classification, the less cost spent on rework. To perform fast inspection and classification of surface defects, AOI needs to execute near-real-time image processing via acceleration technologies, such as Intel® FPGAs.



Accurate detection of defects is critical to improving manufacturing efficiency and quality

Smart cities

Traffic management solutions support vehicle and pedestrian detection for cities monitoring traffic flow, reducing congestion, and increasing citizen safety. With AI, fleet managers can easily be notified of hazardous driving. In these cases, the MXE-210 sends an alert to the dispatch center, which can implement driver training, reschedule the shift, or deploy any other necessary correction programs.

Dangerous driving behavior detection

Fleet managers can use dangerous driving behavior detection to identify hazardous driving behavior by bus and truck drivers due to distraction.

Drivers are monitored in real time.

Video is streamed to the MXE-210.

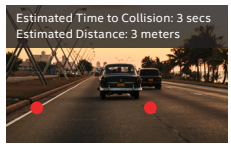
MXE-210 with the Intel® Movidius™ Myriad™ X VPU acts as an inferencing platform, detecting lane departure and providing an estimation of the distance to nearby vehicles and time to collision.

The MXE-210 is also used as a gateway to alert the dispatcher center to the hazardous incident.

Dangerous driving detection uses AI to identify dangerous driving behavior due to distraction

Lane departure detection

Lane departure detection allows fleet managers to monitor hazardous driving behavior due to distraction or fatigue. Lane departure detection solutions are ideal for use in fleet management for trucks, buses, and school buses.



Lane markings are monitored, and information is provided, including estimated distance to nearby vehicles and estimated time to collision.

Camera captures road traffic and streams the images to the MXE-210*.

MXE-210 with the Intel® Movidius™ Myriad™ X VPU acts as an inferencing platform, detecting lane departure and providing an estimation of the distance to nearby vehicles and time to collision.

The MXE-210 is also used as a gateway to alert the dispatcher center to the hazardous incident.

Lane departure detection uses AI to monitor potential collisions and inform dispatchers

How it works

Edge compute helps customers turn massive volumes of machine- and device-generated data into actionable intelligence closer to the source of the data. The ability to filter raw edge data with minimal human intervention helps reduce the amount of data which must be stored and transmitted to downstream systems. It also helps reduce the impact of network latency and cost by taking the computing power from the server-side to the field and minimizing resources consumed.

Touch Cloud's AI software engine, developed using Caffe* and TensorFlow*, conducts video data analysis and processing via the ADLINK edge computing platform powered by the Intel Atom® processor. The result is near-real-time image and video streaming from ADLINK devices, coupled with detection, trigger event monitoring, and back-end system response.

Neural networks based on Intel FPGAs are designed and modified by Touch Cloud to meet specific manufacturing or smart city requirements with customization leveraging different AI and deep learning algorithms. Touch Cloud provides the visual recognition for detection, classification, and pose estimation tasks. Deep learning and AI model training improves performance and accuracy. Intel's OpenVINO toolkit enables Touch Cloud to convert trained AI models to run on the Intel® Core™ processors, Intel Atom® processors, and Intel Movidius Myriad X VPUs.

ADLINK edge computing platforms enable seamless connection, aggregation, filtering, and data transmission to the cloud. Designed for ruggedized, embedded systems, edge computing platform features include:

- High performance per watt and per dollar
- Field protocol control interfaces
- Edge-to-cloud connectivity
- Function expansion for image acquisition, I/O control, and motion control
- Embedded components ensure long term availability

Intel® Vision Products integrate advanced software and hardware to capture complex, dynamic visual content from the edge to the cloud, with exceptional richness and accuracy. By delivering data processing flexibility at the edge—both in cameras and on-premise servers—as well as scalability in the cloud, these solutions are driving next-generation artificial intelligence and analytics, and enabling powerful deep learning inferencing capabilities across various industries.

Open Visual Inference & Neural Network Optimization (OpenVINO) toolkit

This toolkit from Intel enables developers to easily integrate deep learning inference into their applications using industry-standard AI frameworks and standard or custom layers.[3] These can then be deployed across the continuum of Intel-based product lines—from camera to cloud—irrespective of the target platform on which they will be run.[2] With OpenVINO, developers can write code once and make it future-proof for fast, seamless deployment across current and future Intel® hardware—eliminating application redevelopment.[4] Based on convolutional neural networks (CNN), the toolkit extends workloads across Intel® hardware and maximizes performance.

Intel FPGAs

The Intel FPGAs provide the flexibility to program and reprogram the rate of acceleration as needs evolve, all with less power than can be obtained with fixed-function GPUs. They deliver hardened floating point digital signal processing to speed complex machine learning algorithms using parallel processing.

Intel® Movidius™ VPUs

Intel Movidius VPUs are designed to bring vision technology out of the data center and into devices at the edge. Intel Movidius VPUs have a dedicated architecture that offers power efficiency for high-quality image processing, computer vision, and deep neural networks, making them suitable for the demanding mix of vision-centric tasks in modern smart devices. These VPUs are ideal for conditions constrained by size, power, and cost, offering the optimal balance of power efficiency and high computing performance.

ADLINK

ADLINK offers emerging edge computing platforms that converge data and video processing to support AI applications. Its solutions integrate Intel® processors and Intel Movidius Myriad X VPU to deliver hardware-accelerated deep learning processing with high performance per watt and per dollar, end-to-end connectivity to break down information silos for data-to-decision application enablement, and industrial environmental compliance to meet the extended life-cycle requirements of industrial and urban applications.

The company's robust, reliable deep learning accelerators and platforms ensure system compatibility and solution scalability to enable seamless transition to AI integration for operational improvements, performance boost, and efficiency gains across industries. ADLINK builds intelligent middleware for remote monitoring into all of its boards and modules and offers certified solutions for highly regulated markets.

Touch Cloud

Touch Cloud creates AI software for industry 4.0 and surveillance using deep learning, providing massive and high-dimensional numerical data analysis for automated plants and cities. The company's AI processes leverage continual streaming data at the time and place when it is acquired. Edge capabilities eliminate the roundtrip to the back-end server, reducing latency and accelerating response. The AI solution provides near-real-time insights, so that operators can make decisions faster, more efficiently, and with more accurate information. The solution enhances security, since data is not transported across the network or stored in data centers, and helps industrial facilities and city agencies to optimize costs.

The Touch Cloud solution supports modern scenarios requiring real-time observation and response times in milliseconds (such as defect detection) that cannot be achieved with a traditional server-based AI setup. Touch Cloud runs AI on ADLINK edge devices, with high levels of performance and accuracy, to help facilitate abnormality prediction and root cause analytics.

Conclusion

Video is a critical source of AI data—providing rich, near-real-time data that is both ongoing and contextual. For today's organizations, gathering streaming video data is insufficient—they need to be able to quickly analyze, index, and search.

ADLINK, Touch Cloud, and Intel are helping a broad spectrum of vertical sectors, such as manufacturers and smart cities, attain connected, fault-free performance, actionable intelligence, and transformative insight.

"The Touch Cloud AI engine benefits IIoT, bringing cost savings, operational efficiency, and more reliable, high-quality defect classification to critical manufacturing processes."

—Simon Lee, CEO, Touch Cloud

Learn More

See the latest Intel® Vision Products at **intel.com/visionproducts**.

Download the OpenVINO toolkit for designing computer vision solutions at **software.intel.com/en-us/openvino-toolkit**.

For more information about Intel IoT Technology and the Intel® IoT Solutions Alliance, please visit **intel.com/iot**.

Discover ADLINK IIoT, smart vision, and AI solutions at adlinktech.com or contact us at **info@adlinktech.com**.

Explore Touch Cloud AI solutions and applications at **touchcloud.com.tw** or contact us at **info@touchcloud.com.tw**.

1. SKL (Caffe* → OpenVINO™): 8.3 → 93. (See table below.)

2. SKL (OpenVINO™ → Intel® Vision Accelerator Design): 93 → 163. (See table below.)

Platform	Deep Learning Framework	Deep Learning Topology	Batch size	DL Benchmark (measured by FPS)		
				Intel® CPU/CPU	Intel® GPU/SoC	VPU
Intel Atom® processor E3950	OpenVINO™	GoogleNet*	1	8 ~ 14	18	N/A
Intel Atom processor E3950	Caffe*	GoogleNet	1	0.72	N/A	N/A
SKL (Intel® Core™ i7-6820EQ)	OpenVINO	GoogleNet	1	93	50	N/A
SKL (Intel Core i7-6820EQ)	Caffe	GoogleNet	1	8.3 (x2) (x3)	N/A	N/A
Intel Core i7 + Intel® Vision Accelerator Design with Intel® Movidius™ VPU	OpenVINO	GoogleNet (Intel Vision Accelerator Design 01.02.12)	1	N/A	N/A	163 (81.5 x 2)

3. The broad set of popular frameworks and topologies supported include, but are not limited to, Caffe*, Caffe2*, MXNet*, neon*, TensorFlow*, Theano*, and Torch*.

4. While any standard algorithm will run on any Intel® silicon architecture, performance may vary from one architecture to another. In some cases, extra work may be needed using the OpenVINO™ toolkit to port an algorithm from one architecture to a different architecture.

Performance results are based on testing as of September 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No product can be absolutely secure.

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more information go to intel.com/benchmarks.

Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Performance varies depending on system configuration. No computer system can be absolutely secure. Check with your system manufacturer or retailer or learn more at intel.com/iot.

Cost reduction scenarios described are intended as examples of how a given Intel-based product, in the specified circumstances and configurations, may affect future costs and provide cost savings. Circumstances will vary. Intel does not guarantee any costs or cost reduction.

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