ADLINK
Leading EDGE COMPUTING



An ADLINK Industry White Paper

Evolving Manufacturing Connectivity

Part II: Single Solution Turns PC-based Machine Brownfields Green

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As manufacturers seek to employ IoT technologies to generate Cyber Physical Production Systems connecting all production elements, Machine-to-Machine and Machine-to-People communications can fully support data analysis and application required to improve efficiency and boost competiveness. As a result, the Industry 4.0 Smart Factory paradigm ceases to be an abstract concept and emerges as a fully functional implementation. Even so, challenges remain, on the production floor and elsewhere, resolution of which is required to streamline Smart Factory implementation.

For existing facilities, a major obstacle can be the acquisition of real-time data from standalone legacy machines which were never originally expected to communicate with the surrounding landscape.

These legacy machines are equipped with a wide variety of protocols and operating systems. Further complicating standardization efforts, in many cases equipment manufacturers have not released machine source code in the interest of securing IP, with, in some cases, the manufacturer having ceased to even exist. Finally, many owners and floor managers, out of concern for asset protection, are strongly opposed to invasive methods by adding new programs into the machine. IT managers are reluctant of getting these machines networked, fearing security breach as well as network bandwidth limitation.

While methods exist of extracting data from legacy machines, the acquired data is frequently insufficiently detailed to analyze production status and behavioral patterns and is never current enough to provide actionable information.

The existing reality of fragmented technologies, legacy OS, concerns for IP protection, reluctance to use invasive methodology, and inadequate real-time data availability are currently hindering many manufacturers' moves toward smart manufacturing.



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Current Methods for Extracting Data from PC-based Machines

There are currently several methods available for extracting data from legacy machines , each with respective pros and cons:manufacturers actively developing new low-noise technologies, effective testing systems with flexible configuration and adjustment of highly accurate multi- measurement.

- **I/O Layer (Fieldbus) communication:**
  Throughout the years, different fieldbus such as CAN, Profibus, CCLink etc were introduced to the market. Till date there is no one major/common protocol that command the market making data extraction at this layer too fragmented. Adding to the complexity, there are many machines controlled through direct I/O, making data extraction near to impossible.

- **File logging:**
  By creating a watchdog interface implementation which records system events directly into files, we may acquire time-stamped documentation of what have happened to/in the system. However, the log files are generated only after the end of production lot or during machine error; it is not real time data and contains limited information. Besides, different OEMs may create different log file data formats, requiring huge effort to parse the files and adding cost to maintenance.

- **OPC-UA implementation:**
  It is a platform-independent architecture aimed to solve device interoperability problems and unify communication protocols of Industry 4.0 implementation. It is an excellent solution for new machine connectivity, but the standard had not been released until 2008 and gets popular in recent years. But in reality, most legacy machines in the factory are not OPC-UA supported.

- **OEM support :**
  Many end customers turn to OEM for help, unfortunately, either the OEM charged at a very high rate or refused to provide such a service. Some OEM may not even exist any more.

- **Tower lights:**
  Tower-light with single or multiple colors is a very traditional indicator for machine status in production. However, it provides only an indicator of the machine operating status. It lacks information for the reasons for why the machine has stopped or idling. These critical information are important for process improvement and machine maintenance planning.

- **Adding sensors:**
  Given the constraint space of the machine, adding sensor is difficult, this may also cause system instability. Sensor is also a very high investment solution. After service to these add-on sensors will also burden service engineer.

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A Fresh Assessment of the Field

While specs and assets can vary wildly among installed legacy machines, they all share a few basic common features. One of these is, of course, an HMI (Human Machine Interface), nominally as a visual display. Among other things, the HMI's operation screen normally presents important production and machine status information, specifically to this discussion, details of the current status.

Capturing the image through the display port and applying mature OCR (Optical Character Recognition) technology on the image capture would easily convert image capture into valuable information.

ADLINK DEX-100 Data Extraction System

The DEX-100, utilizing video transmission capture, can fully analyze machine operations and production status via just the VGA port . DEX-100 with building Operational Domain features allows operator continue operating seamlessly while data continues to extract in the background. The DEX- 100 further enables full remote control, troubleshooting in the event of malfunction or shutdown. Improving on conventional tower light systems, DEX-100 also make M2M possible which in the past, seems impossible and must relay on operators for bridging machine to machine interface. This not only release operators for other more important task, it also ensure much more accurate and precise and efficient operation process.

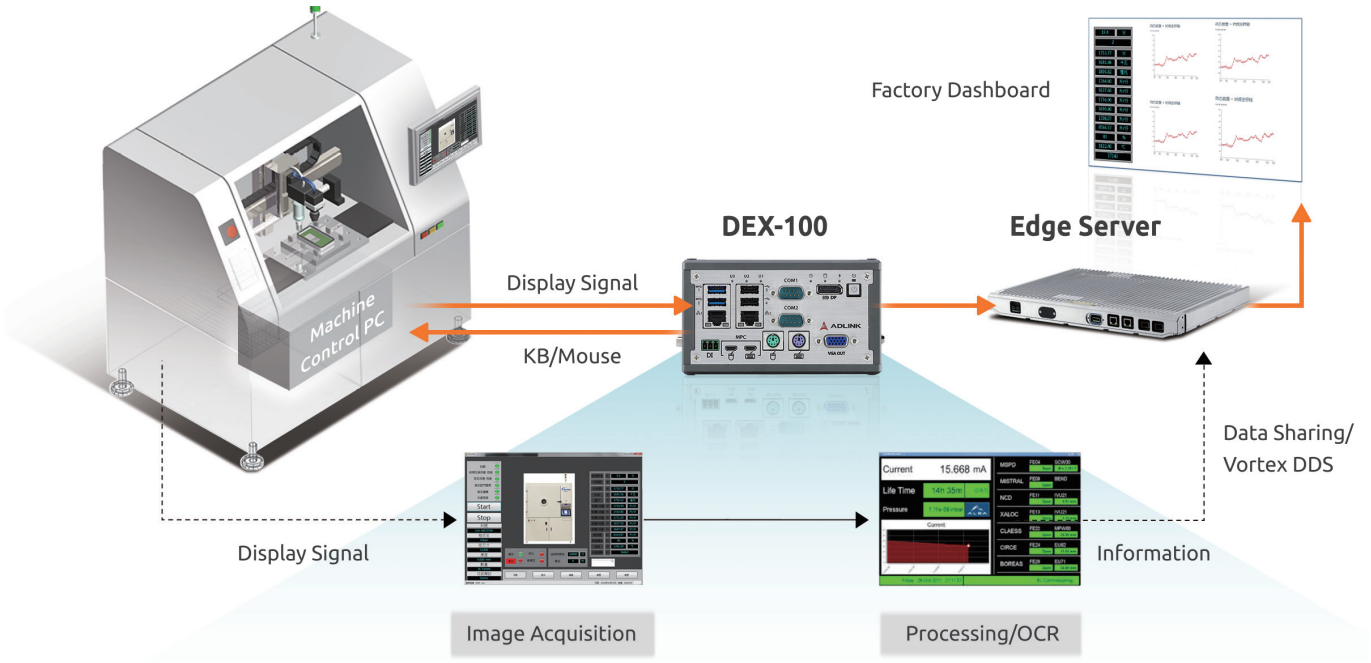


Figure 1. ADLINK DEX-100 combines Intel FPGA technology and OCR technology in a single platform. The interface to the legacy machines is through a standard normalized VGA Interface, enabling maximum scalability and interoperability to all legacy PC based machines. DEX-100 also equipped with multiple configuration tools and scripting software platform, making project integration easier with minimum engineering knowledge skill set required.

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The ADLINK DEX-100 PC-based data extraction system highlights the following capabilities

- **Rich Configuration Tools:** Users or system developers can configure Tag Name, OCR ROI, Script, OP Screen, Page Identifier and Modbus I/O in Edit Mode with ready-to-use system tools.
- **Predefined Operator Screen:** Full Control Mode or OP Screen Mode displays all pre-defined machine tags into a single page display and freeing operators the hurdle of maneuverings to different pages in the machine for desired content. Also provided is One Click buttons allowing display of a pre-defined machine page determined by the operator.
- **Rich I/O Interface:** The DEX-100 provides a Modbus I/O interface for connection with sensors and actuators. Rich I/O configuration also supports connection of Barcode Scanner, and for convenience, a dedicated manual button is provided allowing the operator to switch between Runtime and Full Control modes instantly, in addition to software-based Auto Switch.
- **Secure, Fast M2M Communications:** Fully supported DDS communication framework helps achieve real-time Machine to Machine communication in a reliable, efficient, time-deterministic and secure manner
- **Machine-to-Cloud Connectivity:** The DEX-100 supports DDS, MQTT and Restful communication protocols, enabling vertical communications with the cloud and horizontal communications with edge server and database. Communications with top layer applications can also be established through MySQL.
- **Customized Program:** DEX-100 allows customized program executing on DEX-100, displaying the UI of this customized program on the original legacy machine monitor

Unified Solution Meets the Needs of Brownfield Deployment

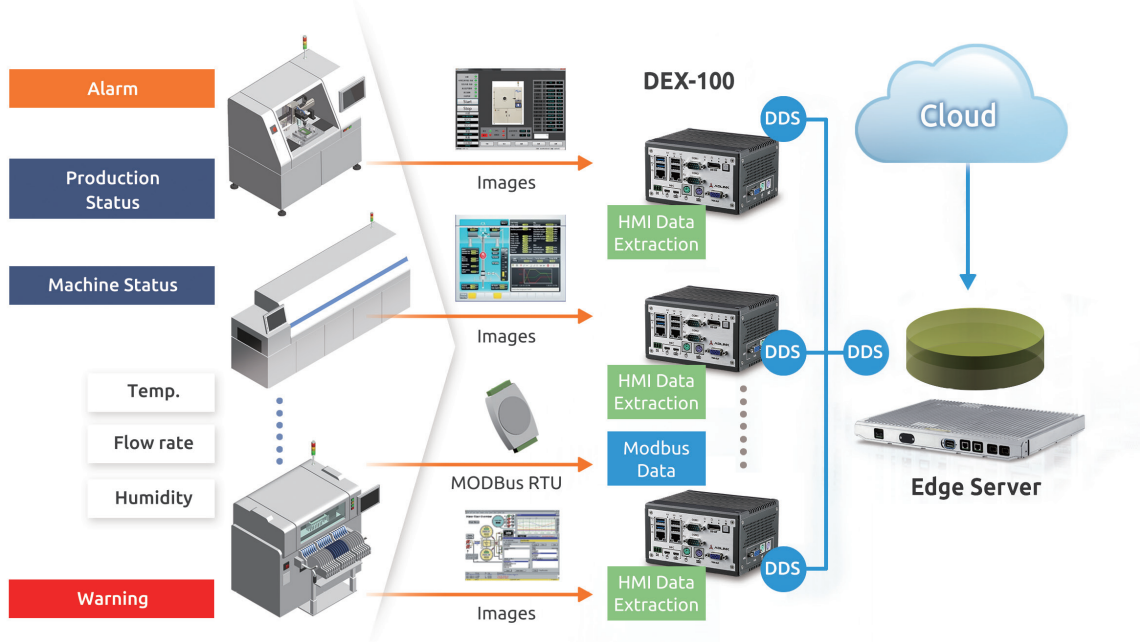


Figure 2. ADLINK, with Intel® IoT technology, has launched solutions that can acquire production and machine status data from legacy PC based machines. These solutions fully support OT, IT and M2M communications as well as Microsoft Azure Smart Factory Suite, for complete end- to-end solutions. ,DEX-100 simply connects its VGA port, mouse and keyboard to existing legacy machine, fulfilling not just data extraction and providing real-time data to topfloor Scada system for monitoring. These data are effectively used for data scientist for process improvement as well as précised machine maintenance plan, improving factory Overall Equipment Efficiency (OEE). The most accurate production data is available for analysis at the cloud platform level to support top level administrative functions such as production prediction and maximized yield.

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Problems in OCR-based data extraction

Although OCR-based solutions present superior viability in meeting the challenges of legacy machine connectivity, several detailed operational challenges can occur during actual implementation into the production line.

- Data contain in multiple pages.
- The operator is presented with considerable disturbance when operating screen keep flickering due to page switch
- Data acquisition can experience interruption in the event of the mouse and keyboard
- Data capture is stalled when the machine warning messages appear

Solutions to the Problems

ADLINK's DEX-100 Data Extraction System, recognizes these challenges and addresses them directly.

Problem: Desired information is located on different display pages, requiring switching between multiple pages for data extraction
Solution: The DEX-100 provides Auto Page Switching via mouse and keyboard simulation signal, configured by Auto Scripting.

Problem: During data extraction, constant display flicker from continuous page switching is distracting and disruptive.
Solution: While the monitor is now connected to the output of DEX-100 instead the machine PC, DEX-100 would select only the current page interested by the user ensuring no display flickering issue.

Problem: When warning or alarm messages are issued, displayed content is blocked and data extraction interrupted.
Solution: The DEX-100 buffers the warning message and continue displaying this message on the monitor until user take action to remove the message away. But at the background, DEX-100 removed the warning windows from the machine PC automatically and continue with data extraction. This process minimized data lost.

Problem: During production, user may need to access physical mouse/keyboard to operate the machine which cause intervention and data lost.
Solution: The DEX-100 acts as a bridge between physical keyboard/mouse and machine keyboard/mouse input signals. Actual intervention takes place on the DEX-100 side, and is then buffered while data extraction continues. When appropriate, the DEX-100 transmits the required action to the machine side, without affecting data extraction.
To reduce physical keyboard/mouse intervention, the OP Screen Summary Page and one-click machine page pre -definition reduce the frequency of physical machine navigation in Full Control mode.

Easy to integrate, Intel to modular system encourages industries to upgrade to IoT

For the manufacturing industry, IoT technology integration requires joint cooperation among many operations. ADLINK has fully combined Intel® hardware and innovative cloud applications that are both easy to integrate and highly expandable, allowing legacy production lines to achieve Internet connectivity in the most economical and convenient manner possible.

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About ADLINK

ADLINK Technology is enabling the Internet of Things (IoT) with innovative embedded computing solutions for edge devices, intelligent gateways and cloud services. ADLINK's products are application-ready for industrial automation, communications, medical, defense, transportation, and infotainment industries. Our product range includes motherboards, blades, chassis, modules, and systems based on industry standard form factors, as well as an extensive line of test & measurement products and smart touch computers, displays and handhelds that support the global transition to always connected systems. Many products are Extreme Rugged™, supporting extended temperature ranges, shock and vibration.

ADLINK is a Premier Member of the Intel® Internet of Things Solutions Alliance and is active in several standards organizations, including PCI Industrial Computer Manufacturers Group (PICMG), PXI Systems Alliance (PXISA), and Standardization Group for Embedded Technologies (SGeT).

ADLINK is a global company with headquarters in Taiwan and manufacturing in Taiwan and China; R&D and integration in Taiwan, China, the US, and Germany; and an extensive network of worldwide sales and support offices. ADLINK is ISO-9001, ISO-14001, ISO-13485 and TL9000 certified and is publicly traded on the TAIEX Taiwan Stock Exchange (stock code: 6166).

About the Intel® Internet of Things Solutions Alliance

ADLINK is a Premier member of the Intel® Internet of Things Solutions Alliance. From modular components to market-ready systems, Intel and the 400+ global member companies of the Intel® Internet of Things Solutions Alliance provide scalable, interoperable solutions that accelerate deployment of intelligent devices and end-to-end analytics. Learn more at: intel.com/iotsolutionsalliance

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