Standards-based Solutions Help Accelerate Development of Connected Vending Systems

Dirk Finstel – Executive Vice President, Module Computer Product Segment, ADLINK Technology
Performance and Profits Improve with Building Blocks, Connectivity and Cloud Services

Modern day vending machines have been around for decades, delivering snacks and sodas at the push of a button. But today these simple machines are getting much smarter, thanks to the Internet of Things (IoT)—a new world of connected devices that share real-time data in meaningful ways. The basic promise of an IoT-connected vending machine is remote maintenance and inventory status, as well as the ability to more closely track incoming revenue. But with the right embedded technology, smart vending machines will also dispense data in addition to the service or product sold. They’ll track consumption, reconfigure in-machine currencies during shipment to their installation country, respond to gesture control or smartphone-like touch user interfaces, track users’ eye movements or facial expressions and serve up context-aware advertisements for the machine’s products and other services like movies or music downloads.

Software updates and maintenance costs of a vending machine park can easily run as high as $200,000 a year, with a predicted lifetime of 5-7 years. By creating smart, connected machines, costs can be lowered by as much as $150,000 per year in reduced maintenance, optimized inventory, upselling products, firmware and GUI changes or even consumer demographics used or sold to other ventures. In fact, the whole supply chain can be positively affected. Eyeing these big numbers, vending operators are seeing the value that comes from more sophisticated embedded hardware and software – from high-res cameras for machine vision facial or gesture recognition and multiple smartphone-like touch screens with 1080p graphics, to wireless and NFC connectivity.
The transformation to intelligent vending is being addressed with new standards-based “building block” or modular solutions, paving the way for new system development, as well as painless upgrades to legacy machines. Many off-the-shelf IoT solutions today incorporate advanced security and automated agents for easy set-up of devices, flexible and ready-made communications gateways and a broad analytics infrastructure to help universally realize the greatest value from customer and machine data. Vending machine operators utilizing embedded building blocks and cloud-based management services can perform repairs, maintenance and upgrades within a single centralized operation. Cloud services allow for remote monitoring of machine status, diagnosis of problems and complete system management from anywhere, at any time, over the Internet. The overall impact on business operations is significant, including greater profitability resulting from higher sales and lower operating costs.

Creating Intelligent Vending Platforms

Replacing the historically limited performance of the Video Machine Controller (VMC) with more powerful embedded control and monitoring solutions ultimately creates the platform for intelligent vending. A range of small form factor platforms can include a vending machine I/O (VMI) board that integrates the

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Intel® Reference Design for Intelligent Vending as a means of accelerating development.

Standards-based form factors such as COM Express®, Qseven or SMARC® computer-on-modules or PC/104 or PCI-104 single-board computers (SBC) and Mini-ITX motherboards make ideal compute hubs for controlling the machine. Each provides a standards-based design path for VMC function, as well as modern intelligent vending performance, including appropriate control of more sophisticated peripherals to round out the system and an effective user interface.

For instance, even the smaller Compact COM Express® modules allow vending developers to access functionality such as DDR3L SDRAM, support of multiple independent displays and extreme rugged operating temperatures of -40°C to +85°C. Or for lower power requirements, SMARC®-based modules using ARM processors or the latest Intel® Atom™ processor E3800 series system-on-chip can offer thermal design power (TDP) as low as 5 W while still supporting camera interfaces to capture customer interaction.

Alternatively, an all-in-one SBC, which may reside inside a panel PC, can communicate to in-machine peripherals and sensors via a local bus. Choices include a multi-drop bus (MDB), CAN bus, or even I2C or SPI (depending upon peripheral and sensor speeds). If additional local intelligence is required, such as for multiple graphics controllers or signal processing for machine vision (facial recognition or gesture control), I/O boards can be added and connected to the SBC via inter-board connections such as PCI Express.

In addition, industrial, touchscreen PCs designed for rugged environments can offer a myriad of smarts built right into the touchscreen itself. With good mechanical construction and IP65 ratings, these touchscreens are resistant to water, dust and chemicals and are
available in both projective capacitance and 5-wire resistive touch. This addresses the spectrum of user interface requirements that developers may need to consider – for example, implementing pressure-sensitive screens in commercial environments or non-pressure, touch-sensitive options in healthcare settings (e.g., pharmaceutical dispensing) where users may need to wear gloves.

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If “local intelligence” is not established with processor(s) embedded in the machine itself, it may be handled close by in an intelligent gateway device. This external intelligent gateway device can be interfaced to one or more legacy machines to provide the embedded processing needed, connecting to machines’ internal sensors via an internal I/O adapter board. Gateways are integrated, pre-validated solutions that streamline IoT application development and securely connect these machines to the cloud.

Reducing the High Cost of Maintenance

The addition of internal sensors to monitor the machine itself will benefit machine operators through predictive maintenance and remote diagnostics. For example, internal temperature monitoring can keep tabs on perishable products such as
food or drinks. Temperature sensors can also monitor the machine itself—at first activating local cooling fans, but also observing mechanical assemblies, bearings, solenoids and other moving parts. Similarly, resolvers, tachometers and current-sensing devices measure increased power usage of internal sub-systems. Elevated temperatures and higher current draws can be indicative of future problems, and monitoring this data remotely allows an operator to predict eventual failures and schedule service prior to a catastrophic event.

A cloud management application must start at the device level in order to collect data that can be used for the Holy Grail of IoT—business analytics. One method of gathering device and system-level data is through onboard board management controllers (BMCs), which can provide statistics related to system uptime such as fan speed, power consumption and CPU temperature.

In this scenario, cloud services are essentially the backend for data and device management, including remote monitoring and control of vending machines. Using a web dashboard, users can quickly access device status and activity logs. This data is securely exchanged behind a firewall and stored for business queries and visualization. Detection and alerting are based on user-defined rules and thresholds. As needed, operators can initiate machine management functions such as restart, software updates and diagnostics. The data can tell operators which machines need to be visited first and the most fuel-efficient routes for service trucks can be mapped; CPU temperature can be monitored for clues about machine performance and anticipated replacement of electronic components prior to failure. These functions can be programmed to sound an alarm to operators, as well as execute a preemptive action like moving to backup battery in case of a pending failure.
Many cloud services platforms provide web-based APIs that enable customization and expansion. As a result, vending OEMs have a ready platform for device management and the addition of external applications. OEMs can query the status of vending machines, group them together for performance updates or define rules for alarms and automatic notifications. OEMs can develop their own strategic external applications that retrieve vending machine data for processing—blending information with other internal data sources and ultimately applying Big Data analytic services such as predictive maintenance modeling.

A New Approach to Monitoring and Managing Inventory and Logistics

With smart vending machines, operators gain valuable insight into how vending machine customers are engaging with the machine and its products. While internal sensors can predict maintenance and service requirements, they can also arrange for suppliers to stock machines that need it most, instead of burning fuel in trucks on a pre-defined (and unnecessary) route. Cloud services brings a variety of machine data for operator visibility, seamlessly transmitting data among the field, data center and logistics. Data from machines scattered about a city or country can be rolled up and examined—from internal temperatures to a chart of what products are selling best and where. Machines can report on their own needs for maintenance, as well as fresh inventory. Inventory can be detected by weight and refrigeration of products can be monitored for ideal settings. Data on
stock shortages can be automatically delivered simultaneously to data centers, logistics hubs, fleet managers and warehouse operations for quick and efficient action. Maintaining inventory can be based on data illustrating real-world user consumption. Costs are reduced, logistics are streamlined and the most popular products remain in stock, keeping happy customers coming back for more.

Exploring the Value of Big Data with Cloud Services

The cost of the hardware, software and data connection is offset by the benefits discussed in the sections above. Cloud connectivity dashboards are where the machines’ remote data realizes its goals. Once smart vending machines are in place, revenue creation and maximizing uptime will rely on massive amounts of data from a company’s machines. Dispensing product—be it coffee, prescription medicine or digital cameras—is only one part of the revenue stream for machine vendors. With built-in sensors and aggregated data from multiple machines, consumer demographics—from a person’s age and gender to individual buying habits—can be uploaded to the cloud for monetization.

Smart Vending Machines Are Smart Business

Reducing costs and opening up new business opportunities are key drivers fueling the growth of the intelligent vending market. With real-time cloud access to critical machine information, vending routes no longer need to be calendar-based, but instead can be predicted and managed dynamically. Maintenance activities become condition-based, using current data from the machine that identifies worn parts for replacement prior to failure. Inventory is managed more effectively, with the right products being restocked at the right time. At the same
time, intelligent vending is a powerful new business model, offering customers a richer, more engaging purchasing experience. Smarter, more connected systems are creating new transaction and payment models and transforming back-end business operations with cloud-based remote management, diagnosis and real-time business analytics. With embedded intelligence built into smart vending machines, plus cloud connectivity, all kinds of new scenarios become possible.

With intelligent systems, vending OEMs reduce operating costs, simplify deployment, increase sales and have a path to new revenue streams from more sophisticated services based on authentic customer metrics. For vending OEMs and system designers, standards-based building block solutions and communications platforms are accelerating development and bringing new competitive opportunities to the vending market.

Dirk Finstel
Dirk Finstel is the Executive Vice President of the Module Computer Product Segment with ADLINK Technology. Mr. Finstel has 20+ years of in-depth experience in leading embedded computer technology, with a proven track record in embedded modules. He has held executive-level positions at embedded computing companies since he founded Dr. Berghaus GmbH & Co. KG in 1991, and has been responsible for global technology, as well as research and development and setting technological strategy. Mr. Finstel holds a B.S. in Computer Engineering & Science.

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