



Scaling Smart Vending Machine Deployment

How AAEON Engineered the Perfect Outdoor-Ready Embedded Platform

Overview

Vending machines can be seen as the precursor to modern smart retail, with public perception of their improved convenience and efficiency mirroring the sentiment that frictionless shopping, digital out-of-home (DOOH) advertising, and smart shelves elicit today.

Embodying this progress, a leading provider of frozen vending services sought an embedded platform able to power a line of outdoor smart vending machines with the purpose of dispensing a range of frozen meals, snacks, desserts, and local treats.

To this end, the project mission was to develop an intelligent solution that could not only be deployed in any setting, but could efficiently automate and streamline every aspect of the operation and management of a fleet of vending machines at scale.

Given its established history of bringing innovative [smart retail projects](#) to market, as well as its reputation as a premier provider of customization services, the company turned to AAEON to build an embedded solution capable of meeting their project requirements.

Pinpointing Project Pain Points

Outdoor Deployment



The first of a number of key challenges the customer faced was making sure any embedded board or system used had the environmental durability needed to operate in a relatively rugged setting.

Given the customer's vending machines would be installed outdoors, the embedded solution used would need to be incredibly durable.

This was especially important as the failure of the embedded platform would not only mean lost revenue due to machine downtime, but also result in the company directly incurring the costs of the perishable frozen food items the vending machine stored.

Chromium-Based GUI

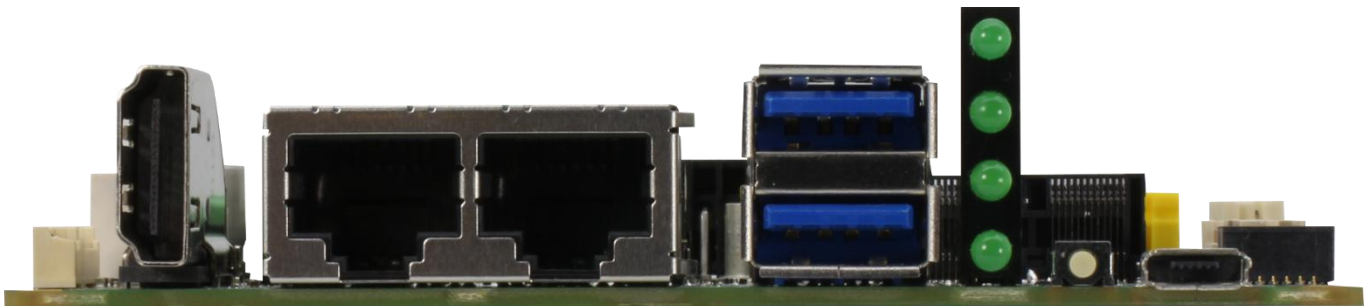
On a similar note, the client's brand was tied to a reputation for high quality, and so they requested the embedded platform support a touchscreen interface with high-resolution display graphics to maximize customer satisfaction.

As a means of achieving this, the customer requested the application run with Chromium as the GUI platform, which brought several benefits.

First, Chromium was well-suited for hosting polished, visually rich interfaces. Additionally, Chromium came with the native benefit of kiosk mode, full-screen launch, and the ability to disable system controls to make it an extremely secure and tamper-proof environment, something that is particularly critical for unattended, low-maintenance deployments such as outdoor vending machines.

All-in-One Device Support

Outside of durability concerns, the primary barrier to developing such an application is typically finding an embedded platform with the necessary balance of wired interfaces and stable cloud connectivity.



The vending machine would serve multiple functions, including as a display kiosk, POS, refrigerator, and inventory management system, meaning its controller had to have an extensive set of interfaces for the installation of peripheral devices such as sensors, display screens, and payment modules. This is a difficult task given the limited space within the machine and the mechanical limitations of many embedded platforms.

AAEON's Custom Solution



Given the client's complex needs, AAEON leveraged its vast experience in providing tailored [ODM platforms](#) to suit the exact specifications of the project, working closely with the customer to ensure both the hardware provided for the vending machines would perform reliably under the conditions required, but also to fulfill the customer's software integration needs.

Due to the space-constrained nature of the deployment within the client's vending machine, the 100mm x 72mm Pico-ITX form factor was deemed most suitable, given it could support both a highly dense I/O and embedded CPU.

Compact Environmental Resilience

Addressing the first challenge of ensuring reliable operation in a space-constrained, somewhat tough outdoor deployment setting, AAEON's custom Pico-ITX platform was built to the exact specifications needed.

To avoid damage or failure as a result of temperature fluctuations, the board was built, tested, and validated to [AAEON's WITAS1 standard](#), which meant it could function optimally from -20°C all the way up to 70°C.

Furthermore, the variety of locations in which the vending machines would be installed meant that the power supply available would vary, and so the board was also designed to tolerate power input ranges between 12V and 24V, preventing data loss and failure as a result of power supply volatility.



Software Fine-Tuning for Enhanced Multimedia Performance

To address the customer's need for power-efficiency, multimedia performance, and Chromium-compatibility with hardware-accelerated decoding, AAEON chose the MediaTek Genio 510 as the board's processing platform.



However, the customer requested the application use Debian 13 as its OS, which is not supported as standard by the MediaTek Genio 510 platform, which typically uses Yocto or Android. To remedy this, AAEON worked with a MediaTek-endorsed third party to build a fully customized Debian 13 image tailored for the MediaTek Genio 510 platform.

This customization included kernel, driver, and system-level modifications to support hardware acceleration, kiosk deployment, and a range of I/O and networking functions.

In addition to this, Chromium's hardware acceleration was manually enabled to leverage the benefits of the MediaTek Genio 510's Arm Mali-G57 GPU. This approach

meant that the vending machine display could still leverage the hardware-accelerated decoding offered by the MediaTek Genio 510 by integrating its VPU and GPU drivers at the custom kernel level.

With these adjustments, the client had access to the full scope of the benefits on offer when using Chromium for smart vending, such as smooth, interactive, and responsive multimedia displays on the system's display panel.

Expert PCB Design to Maximize I/O Selection

As each vending machine would be a standalone application, AAEON's Pico-ITX board was designed to accommodate a dense selection of interfaces. As such, AAEON designed the board with three serial communication connectors offering both RS-232 and RS-485 signals and multiple USB ports.





With this layout, the board could support all of the necessary peripheral devices needed to manage every function of the vending machine. Reserving one USB 2.0 OTG for OS image flashing, the remaining three USB ports were used to install the machine's payment devices, such as bill validators, coin counters, and barcode readers.

Meanwhile, the board's RS-232 and RS-485 connectors enabled integration with essential peripheral devices such as POS terminals, receipt printers, and a central control board to integrate in-machine temperature, weight, and movement sensors.

As a result, the Pico-ITX could manage both the commercial functions of the machine and essential tasks such as monitoring inventory levels, storage conditions, and motor operation.

Wireless Connectivity for Remote Operation

While the board's connectors handled the vast majority of the day-to-day needs of each vending machine, reliable wireless connectivity was required for remote deployment. To this end, AAEON's Pico-ITX board was equipped with a mini PCIe slot housing a 4G module, which provided a secure connection through which to authorize transactions, send telemetry data to the client for remote monitoring.



In addition to this, the board offered an M.2 2230 E-Key slot for the installation of a Wi-Fi module, which not only acted as an additional cloud communication channel, but allowed remote diagnostics to be carried out without interrupting the machine's other wireless operations.

AAEON's Impact

Following stringent testing to determine the compatibility of both AAEON's Pico-ITX hardware and the third-party vendor's software with the client's vending machine, the project was successfully signed off on and plans to begin the deployment of unmanned outdoor vending machines have begun.

This project offers a comprehensive look at how two of AAEON's core values are consistently applied in real-world applications. The first of these is AAEON's technical prowess when it comes to [flexible customization](#), as represented by the creative solutions enacted to address the challenges faced by the customer throughout the project's development cycle.

Secondly, the customer-centric business approach that AAEON was founded on was truly on full display, with teams across multiple disciplines all working to make sure the client was able to bring their idea to fruition, and ultimately succeeding.

About AAEON

Established in 1992, AAEON is one of the leading designers and manufacturers of industrial IoT and AI Edge solutions. With continual innovation as a core value, AAEON provides reliable, high-quality computing platforms including industrial motherboards and systems, rugged tablets, embedded AI Edge systems, uCPE network appliances, and LoRaWAN/WWAN solutions. AAEON also provides industry-leading experience and knowledge to provide OEM/ODM services worldwide. AAEON works closely with premier chip designers to deliver stable, reliable platforms. For an introduction to AAEON's expansive line of products and services, visit www.aaeon.com.



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