The Trees Have Eyes

AAEON's BOXER-8651AI Brings Vision to the Forest in the Fight Against Wildfires

Introduction

A company specializing in intelligent environmental monitoring approached AAEON with the task of upgrading its forest fire detection system. The client, a leading company in the development of AI-powered remote monitoring systems, previously worked with AAEON, deploying products from its embedded AI system platform range as part of its setup.

However, with the enormous progress made in bringing advanced AI functionality to the edge in recent years, the company wanted a new foundational platform capable of running its more sophisticated and advanced fire detection algorithms to expand the accuracy and coverage of its existing application infrastructure.

Surveying the Project Requirements

Because of the serious threat that forest fires present all over the world, the client had some very specific requirements when it came to selecting an embedded solution to power the project. The first of these was that the system would need to not only be able to run complex AI algorithms on the edge to detect the early signs of forest fires, but that it had to be able to do so accurately and without latency.

The second prerequisite was that the system be robust enough to operate reliably in a harsh outdoor environment. Because the client's fire detection system is designed to utilize multiple nodes spread across remote locations, the hardware used would need to handle wide temperature changes, power fluctuations, and preferably be passively cooled to avoid the additional maintenance associated with fan-cooled systems, which often accumulate contaminants from the surrounding area, causing suboptimal performance.

A further requirement was that the chosen solution be easy to scale, meaning it should be relatively simple to deploy and maintain. Moreover, the company would need to send data from each edge device to a central cloud server with minimal latency, meaning wireless communication was a must.

The BOXER-8651AI on Duty

To power the application, the customer chose AAEON's BOXER-8651AI, a compact fanless embedded AI system equipped with the NVIDIA® Jetson Orin™ NX module.

Satisfying the first of the client's project needs, the BOXER-8651AI leveraged the NVIDIA Ampere architecture GPU of its integrated NVIDIA® Jetson Orin™ NX, with 1024 CUDA® and 32 Tensor Cores to grant the application up to 70 TOPs of AI performance

and dedicated Deep Learning Accelerator fixed-function hardware, making it more than capable of running the client's complex fire detection algorithms with exceptional efficiency.

Measuring just 105mm x 90mm x 52mm and weighing only 2.4 lb. (1.1Kg), the BOXER-8651AI is the market's smallest fanless system equipped with an integrated NVIDIA® Jetson Orin™ NX module.

In addition to this, the system is able to operate in temperatures as low as -15°C and as high as 55°C without the need for fan-assisted cooling, eliminating concerns about deployment in regions with different climates or the need for frequent maintenance due to contaminants entering its chassis.

The same benefit can be attributed to its broad 12V to 24V power input range, which meant the BOXER-8651AI could be installed in places with volatile power supplies without the risk of failure.

Finally, the BOXER-8651AI made for the perfect option where scalability was concerned, both in terms of its connectivity options and its suitability as an edge node within a broader application ecosystem.

Equipped with an RJ-45 port for Gigabit Ethernet and two USB 3.2 Gen 2 ports, the BOXER-8651AI offered multiple options for camera installation, meaning deployment was as simple as mounting the system with an adequate power supply and one or more cameras installed on the BOXER-8651AI. In this case, the client opted to utilize the system's LAN port for IP camera installation.

For edge-to-cloud data transmission, the BOXER-8651AI offered M.2 3042/3052 B-Key, M.2 2230 E-Key, and SIM card slots for 4G/5G, Wi-Fi, and cellular modules to be installed, respectively. This provided the client with ample options through which its central server could receive automated alerts, even in remote areas without wired infrastructure.

Application Architecture
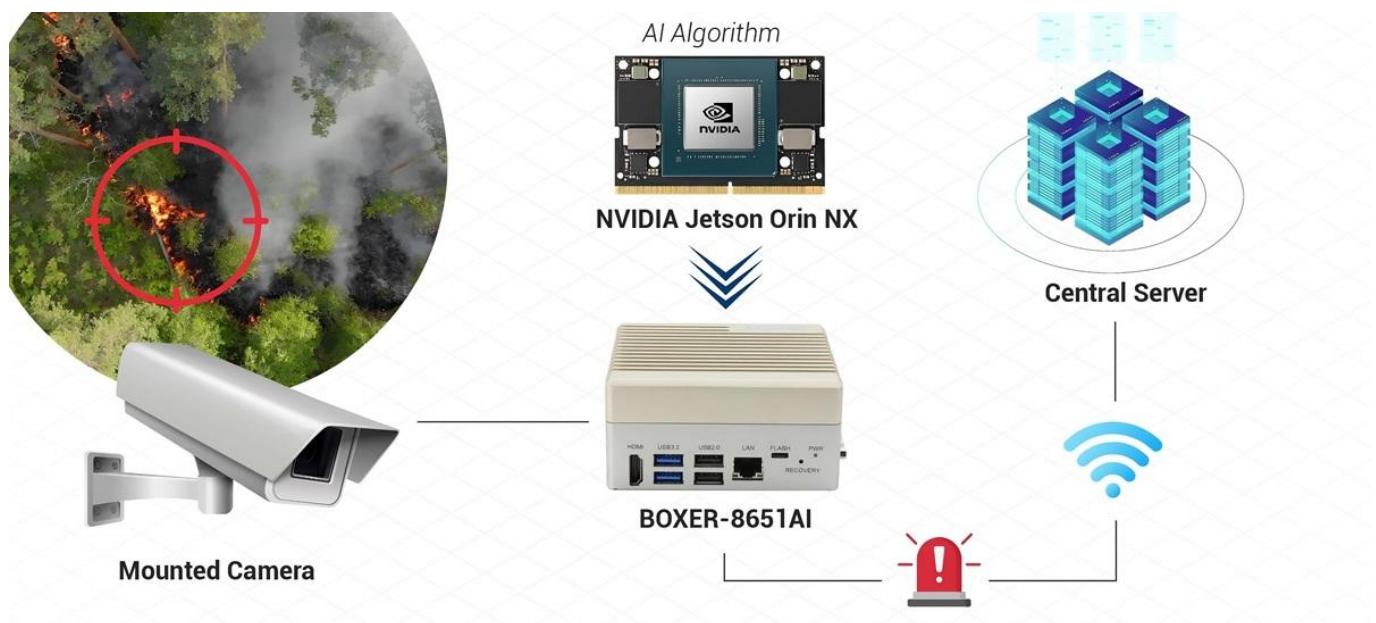
Technical Breakdown

The application's operation can be broken down into three distinct sections:

- Live video acquisition via an IP camera installed via the BOXER-8651AI's LAN port.

- Image analysis using pre-trained deep learning models executed on the BOXER-8651AI's NVIDIA® Jetson Orin™ NX module.

- Timestamped metadata and proactive alerts fed back to the client's central server via wireless communication module installed on the BOXER-8651AI.

The application ecosystem was made up of multiple BOXER-8651AI units distributed across remote zones such as national parks and forests, from which an IP camera was positioned on an observation tower or mounted in forested areas.

This camera would continuously feed live video to the BOXER-8651AI, which would in turn pre-process and run custom convolutional neural network (CNN) and object detection models in real-time to ascertain whether or not key indicators such as smoke or flickers were present in the footage.

In the event the models returned a positive identification of such an indicator, the BOXER-8651AI's preconfigured event handler would instantly issue a wireless alert to the client's central server via its 4G/5G cellular module.

Project Impact

Given the client's prior history with AAEON's embedded AI PCs being deployed as crucial nodes within its fire detection ecosystem, it was aware of the exemplary service and performance on offer when bringing the project to fruition.

Early results have been extremely promising, with the client noting that each unit is able to recognize fire sources as small as 2 square meters at a range of up to 5 kilometers, allowing for greater coverage in remote, forested areas.

In addition to this, the application has thus far boasted a false alarm rate of less than 2 in 10,000 instances, or 0.02%, illustrating the levels of accuracy in early fire detection possible when leveraging AI through AAEON's elite embedded platforms.

A final benefit has been the reduction in manpower required to monitor the application as a whole, with only one member of staff being able to monitor the automated alarms of up to 1,000 edge devices at a time. This not only streamlines the allocation of financial resources for local authorities in charge of environmental monitoring, but also shows great potential where scalability is concerned.

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.