Application Note

Combine EVA with an AMR to Get 24/7 Operation

Autonomous Machines with Computer Vision Can Make Immediate Decisions, With or Without Human Intervention

The number of robots that are employed in industrial applications is growing at a rapid pace. The Industry 4.0 specification talks a lot about how to make those robots operate successfully. When you move to Industry 5.0, a different element is added, namely mixing people and robots in the same work environment.

The robots in these leading-edge environments are known as autonomous mobile robots, or AMRs. AMRs are designed with an array of embedded sensors, which could include a combination of positioning sensors and computer vision, augmented with state-of-the-art artificial intelligence (AI) and deep learning (DL) technologies. Armed with these "smarts," the AMRs can perform object detection and recognition and navigate their way through and around an uncontrolled environment, even in places where the landscape could be constantly changing. AMRs can have an accurate perception of their surrounding environment, enabling close machine-human collaboration without causing harm to human coworkers in the vicinity. Also, the AMRs can detect and avoid obstacles and can stay out of areas that they'd never return—like falling off a steep drop.

AMRs can be great additions to a factory floor or other setting. When combined with EVA, the benefits rise exponentially.

Workers Who Always Comply and Never Tire

The beauty of AMRs, as opposed to humans, is that they can work around the clock and only need to be stopped for maintenance or battery recharging. They are far less concerned with heat, chemicals, etc. And they always perform their duty faithfully and don't get tired.

AMRs can perform a wide array of tasks, including routine inspections of industrial facilities, electrical substations, chemical plants, warehouses, and so on. In these environments, the robots can perform tasks like reading meters, ensuring that things are where they belong, and detecting when something is out of place, such as tools left lying around or objects obstructing entrances and exits, which can be an extreme fire hazard.

Another task for the AMRs is to detect potential problems that would be difficult to see with the human eye, thanks to embedded high-resolution cameras. This could involve corrosion on fittings, cracks in pipes, jets of steam, and drips, leaks, and pools of liquid on the floor. Upon detection, the robot can alert a human operator.

Depending on the work environment that's intended for the AMR, different levels of functionality must be included. For example, a wide operating temperature range may be required if the robot may be exposed to temperature extremes. The same holds true for shock and vibration.

One way to implement the stated features is to embed artificial intelligence (AI) within the robot. But as we know, AI can consume large amounts of compute power, a level that previously was only available in the Cloud. However, sending data back and forth to and from the Cloud can have detrimental effects due to the latencies associated with Cloud computing (and it can be expensive). In many cases, milliseconds can make the difference between a piece of equipment exploding or a pipe bursting. Note that a Cloud-based solution also assumes that the Internet connection will never go down, even for a matter of seconds.

EVA-based Robots to the Rescue

Thankfully, there's a new technology on the horizon, one that makes it possible for AMRs to perform the necessary calculation right at the Edge, within the facility. Known as edge video analysis (EVA), this technology provides the ability to analyze the video on-location in real-time. That includes AI calculations, turning the AMRs into "smart robots." Essentially, this is done by exploiting the capabilities of today's powerful microprocessor units (MPUs) and combining them with even more powerful graphics processing units (GPUs), which boast thousands of small processors. Together, they can perform AI-related tasks in a massively parallel fashion.

ADLINK Makes EVA a Reality

ADLINK Technology designs and manufactures a wide range of products for edge computing applications. The company's edge computing solutions include GPU-accelerated board-, system-, and server-level products, enabling system architects to construct and optimize system architecture for individual edge computing applications. For the company's EVA solutions, system responsiveness is dramatically boosted through the use of NVIDIA GPUs and Jetson family of system on modules.

Most engineers are familiar with NVIDIA's off-the-shelf GPU cards with their integrated cooling fans. Unfortunately, while powerful, these cards aren't always suitable for EVA applications, partly because the off-the-shelf cards are typically intended for use in non-hostile low-risk operating environments, such as, air-conditioned offices or server rooms.

ADLINK's EVA solutions boast more than enough computational power to control the robot in addition to analyzing its surroundings, and they feature ruggedized units that are ideal for use in harsh environments. This obviously makes them suitable for use in AMRs. Such features include lockable connectors that can withstand the rigors of the shocks and vibration that are prevalent in the use of mobile robots. In addition, these systems can be designed with leading-edge passive cooling technology, meaning that no fans are required.

For the EVA solutions, ADLINK's engineering team has designed a series of compact MXM GPU modules based on Pascal and the latest Turing architecture, and edge AI systems based on the Jetson family of system on modules including Jetson Nano, TX2, Xavier NX, and AGX Xavier. These modules and systems address size, weight, and power constraints of EVA but don't skimp on performance. In fact, they provide equivalent processing capability while consuming about half the power (and producing less heat). And they have a longer commercial lifespan than conventional graphics subsystems.

A wide range of camera types are supported in ADLINK's EVA solutions, including USB cameras, Ethernet Cameras, GMSL II Cameras. This allows the AMR's design team to select the optimal cameras for the target application.

Unlike solutions that require all of the robots to communicate via a central hub, which can be envisioned as a Cloud-based architecture, ADLINK uses a decentralized communications protocol that allows the robots to communicate with each other directly in real-time. Using this architecture, the robots can transmit video streams to edge, fog, and cloud servers for additional analysis if required.

Moving forward, it's clear that systems employing edge video analytics will be deployed in various diverse locations, performing a cross-set of applications, all designed to make our lives easier and safer. And rest assured that ADLINK will remain at the forefront of this burgeoning technology.