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Data & Monitoring

NEXCOM

Transforming Hong Kong's Railway Safety with AI-Powered Transportation Management

Background

Hong Kong's railway system epitomises efficiency and connectivity in urban transit. It serves as the city's arterial network, efficiently carrying millions of commuters daily. Renowned for its punctuality and reliability, the railway system stands as a model for urban transportation globally.

Connecting diverse districts, blending residential, commercial and cultural landscapes, its importance as an infrastructural backbone is undeniable.

With this tremendous responsibility, ensuring the safety of railway infrastructures and operations is of utmost importance.

Challenge

All types of transportation infrastructure, including highways, railways and subways, have one thing in common: they face critical challenges in operationalising data across safety, maintenance efficiency and always-on security. Maximising safety while minimising maintenance costs is a massive challenge for any transit authority.

In particular, let's delve into operational safety. Manual inspections can take up to 10 times longer than machine inspections; they are both labour intensive and compromise accuracy.

Inclement weather conditions, such as wind, rain and

darkness, can further complicate manual inspections. Extreme precipitation events have become more frequent in Hong Kong. The hourly rainfall record was broken several times in the last few decades. In consequence, the inspections often fail to monitor the safety of operating tracks. For instance, vegetation intrusion or railway track shift can lead to derailments. Hundreds of incidents occur annually due to undetected infrastructure defects, vegetation and landslides. Unplanned disruptions result in an average of 300 hours of operations lost per year across these sectors.
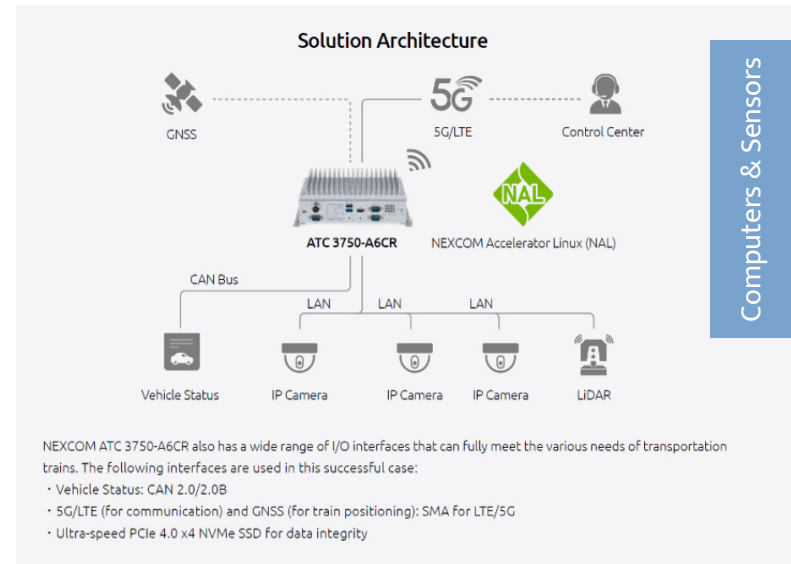
Traditional camera infrastructure and IP cameras often lack depth perception for accurate monitoring. Satellite imagery doesn't have enough precision and is highly dependent on weather and satellite availability. Aerial monitoring is costly, with airspace regulation issues and the requirement for experienced pilots.

Solutions

Advanced computing and AI are the path forward, covering tasks from image processing and optimisation to machine and deep learning, as well as machine vision and object recognition for safety applications, including collision avoidance. NEXCOM, an NVIDIA NPN partner and Metropolis partner, in partnership with **Kodifly (www.kodifly.com),** an NVIDIA Inception partner, a Hong Kong-based spatial intelligence company, deployed the Intelligent Railway Infrastructure System (IRIS), assisting Hong Kong Railways in efficient and safe infrastructure management.

NEXCOM's product, ATC 3750-A6CR, a robust edge AI railway computer featuring the NVIDIA® Jetson AGX Orin™ system-on-module, connects high-resolution cameras and LiDAR sensors by PoE LAN ports as the image and Point Cloud Data (PCD) inputs for machine vision.
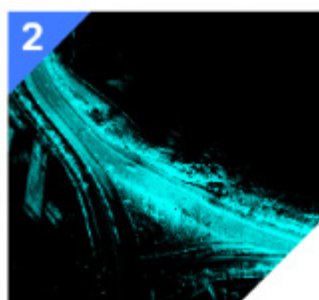
Additionally, NEXCOM offers a comprehensive

Solution Architecture

NEXCOM ATC 3750-A6CR also has a wide range of I/O interfaces that can fully meet the various needs of transportation trains. The following interfaces are used in this successful case:
· Vehicle Status: CAN 2.0/2.0B
· 5G/LTE (for communication) and GNSS (for train positioning): SMA for LTE/5G
· Ultra-speed PCIe 4.0 x4 NVMe SSD for data integrity

software service called NEXCOM Accelerator Linux (NAL), integrating the NVIDIA JetPack™ 5.1.1 software development kit, Ubuntu 20.04, an onboard MCU library and custom-made peripheral I/O functionality drivers. It provides developers with efficient control of the hardware and NVIDIA® Jetson™ system-on-modules through APIs, sample code and I/O utility, facilitating a seamless solution to accelerate customers' app developments. The stable software architecture of NAL made it easy for software vendors to extract train information and develop programmes, allowing their software to successfully interface with the ATC 3750 and meet the requirements of this project.
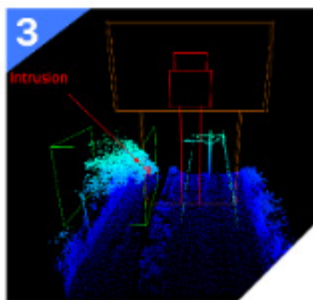
IRIS, the infrastructure monitoring system, is powered by SpatialSense, a LiDAR and camera scanner that can be mounted on any moving vehicle. The SpatialSense and processing device are installed on the train, surveying the railway infrastructure, capturing precise details and creating a digital twin. The software analyses the railway circuit and helps to identify potential concerns, such as intrusions, obstacles or the growth of trees that can cause disruption of service on the tracks. The exact location of potentially hazardous

Scan the infrastrucure　　*Create Digital Twin*　　*Detect Dangerous Objects*　　*Pinpoint the Exact Location*

4 Steps of how the Intelligent Railway Infrastructure System (IRIS) works

instances is pinpointed directly on the 3D map in an intuitive web application. Staff from the control centre can view the alert in real time and immediately rectify the risk, such as by removing trees or repairing rails. This solution can also be used by railway operators to schedule maintenance and troubleshoot problems, helping to prevent accidents.

Moreover, this mobile computer facilitates real-time information monitoring by integrating LiDARs, IP cameras or mmWave radar. It provides essential functionalities such as driving and braking control, collision protection, people counting, traffic light detection, railway ballast bed monitoring, railway station monitoring and anonymised monitoring of drivers' physiological states. These features aim to enhance safety in rolling stock applications.

The railway SKUs for ATC 3750-A6CR, along with the optional power isolation kit VTK PWA series, provide complete power protection. They hold the EN 50155 certification and are equipped with an M12 X-coded connector to prevent wire detachment. In such a complex environment that's exposed to natural elements, a ruggedised solution is required. Equipped with passive cooling and an optional fan kit for hybrid cooling, the ATC 3750-A6CR can effectively dissipate heat over a wide temperature range in harsh environments. These features enable high-speed data processing, efficient operations and excellent connectivity, facilitating real-time obstacle detection for collision avoidance. NEXCOM plays a crucial role in unfenced environments by detecting and eliminating blind spots, where unexpected obstacles like animals or plants may enter, minimising accidents, damage, deaths and delays while maintaining transportation volume and revenue.

Benefit & Result

Improved Inspection Efficiency

By employing the AI solution, the public transportation network can reduce the impact of uncontrollable factors such as weather and labour shortages, significantly lowering costs and improving inspection efficiency.

Improved Prediction Accuracy

Compared to traditional optical sensors, LiDAR can accurately detect the distance, location and shape of objects, collecting data from a wider range by emitting lasers in all directions. In this case, it is crucial to effectively and accurately identify the location of trees and whether surrounding objects will obstruct the train's path.

Reduced Maintenance Costs

According to the reports by the public transportation network and the Federal Railroad Administration, Hong Kong will spend $65 billion on railway asset maintenance and renewal in the next five years. By switching from breakdown maintenance to preventive maintenance, the AI monitoring solution enables substantial savings.

The smart transportation solution, built using NEXCOM's ATC 3750-A6CR and Intelligent Railway Infrastructure System (IRIS), is a game-changing platform revolutionising the transportation industry. The platform provides efficient, cost-effective and safe solutions, and has been widely adopted across numerous vertical markets. It contributes to new standards for innovation and technological advancement in the transportation sector.

ATC 3750-6C
NVIDIA® Jetson AGX™ Orin Solution
Performance Edge AI Computing
· Built-in NVIDIA® Jetson AGX Orin™ SOM
· Designed with rugged, compact and hybrid cooling solutions
· 6-port GbE PoE+ for IP CAM/LiDAR sensors

ATC 3750-A6CR
NVIDIA® Jetson AGX™ Orin Solution
Performance Edge AI Computing for Rail
· Built-in NVIDIA® Jetson AGX Orin™ SOM
· Designed to be fanless, rugged, and compact
· 6-port GbE PoE+ (X-coded) for IP CAM/LiDAR sensors

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