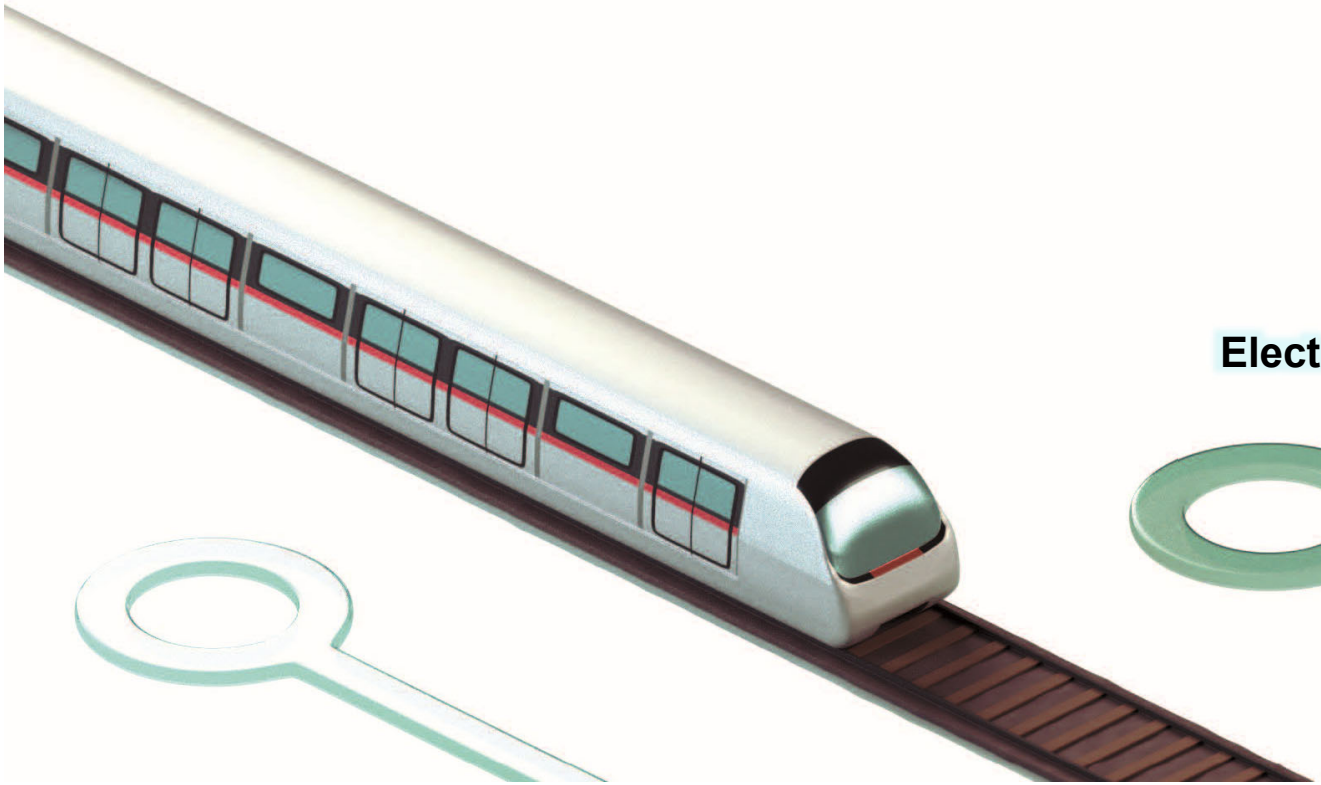
Innovative and Technological Applications to Enhance Railway Safety in Hong Kong - Regulator/Operator Partnership



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Hong Kong SAR Government

Agenda

- Railway Safety Regulator in Hong Kong
- Regulator-Operator Partnership
- I&T Applications
- Conclusion

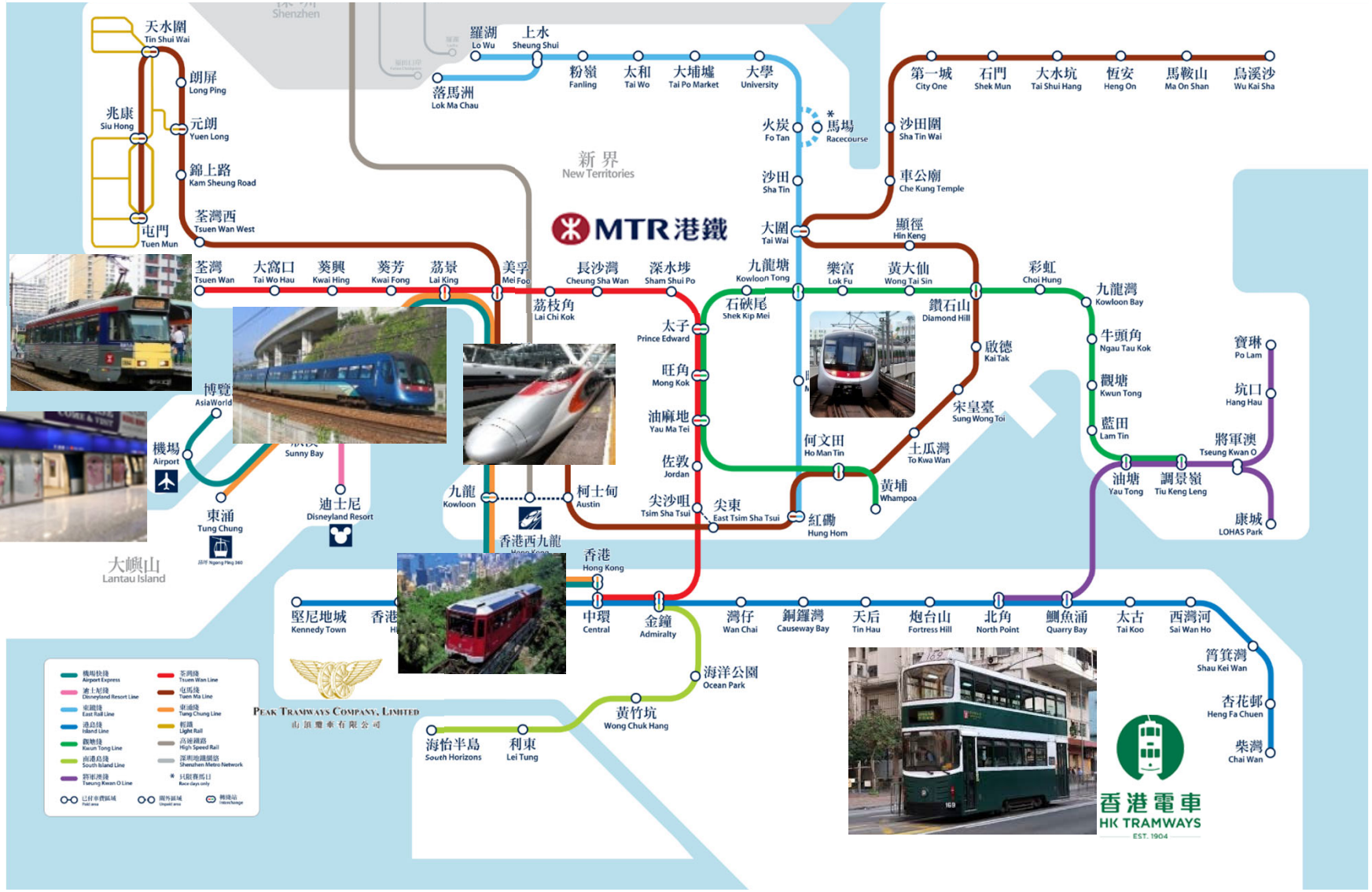
Safety Regulator - Electrical and Mechanical Services Department (EMSD)

Regulatees include:

- Mass Transit Railway (MTR)
- Airport Authority Hong Kong (AAHK)
- HK Tramways
- Peak Tram

Railways EMSD

Hong Kong Railway Lines



Regulator-Operator Partnership

Platform and funding for pilot trial of I&T solutions

Safety Regulator (EMSD)

E&M InnoPortal®

Railway Operators

Wider I&T applications

(MTR, Airport Authority, HK Tramways, Peak Tram)

創新及科技局 Innovation and Technology Bureau

中国科学技术协会交流部

機電工程署 EMSD

广东省科学技术协会

Railways EMSD

Collaboration between EMSD and Operator

I&T Forum

Communication Workshop

Implemented I&T Solutions

- Permanent Way - dynamic track gauge monitoring
- Rolling Stock - pantograph integrity
- Power Distribution – overhead line integrity and stray current leakage
- Stations - escalator small object detection
- Staff - interactive safety training

Real-time Dynamic Track Gauge Monitoring

Problem

- Excess gauge widening can be very serious
- Limited time for dynamic measurement in non-traffic hours

Solution

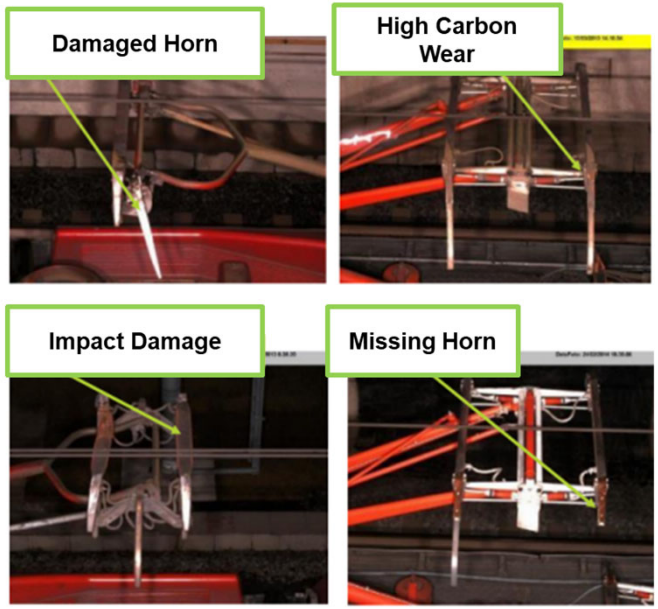
- Measurement of dynamic track gauge on passenger trains
- Real-time result on dashboard/ alert on abnormal findings
- Track maintenance more efficient

Railways EMSD

AI Inspection of Pantograph

Problem

- Pantograph damage



Solution

- 3D reconstruction
- Monitor physical damages

Cameras and Illuminators

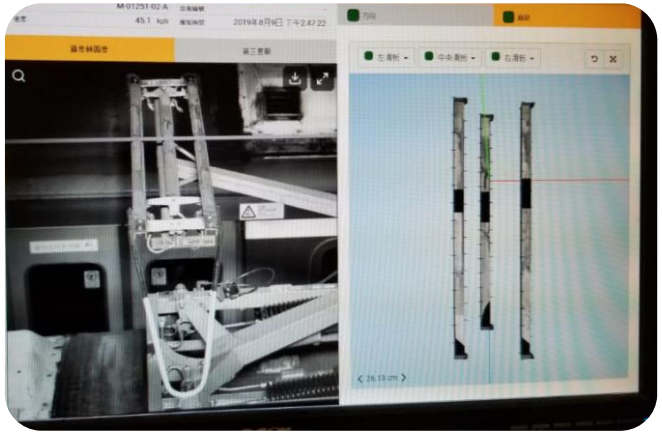


Image processing software

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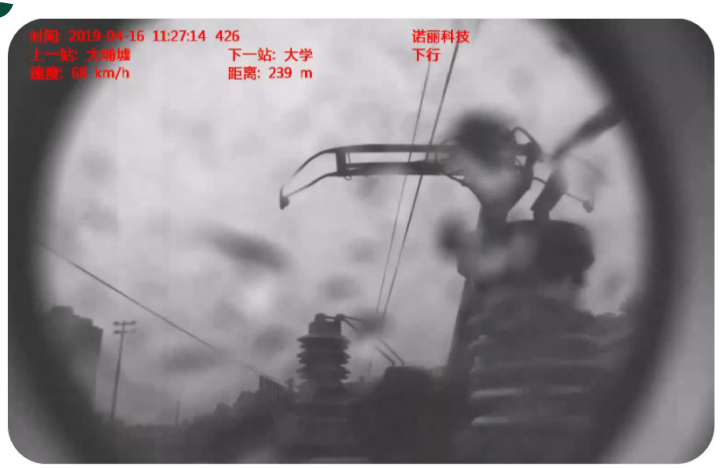
AI Inspection of Overhead Line

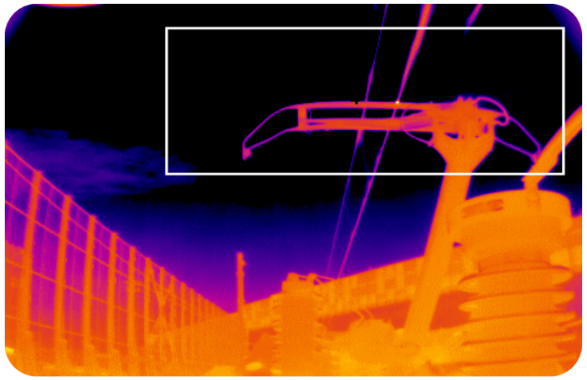
Problem

- Long service interruption in overhead line incident

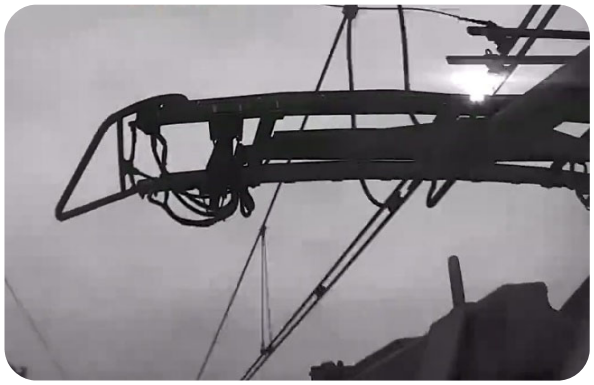


Solution

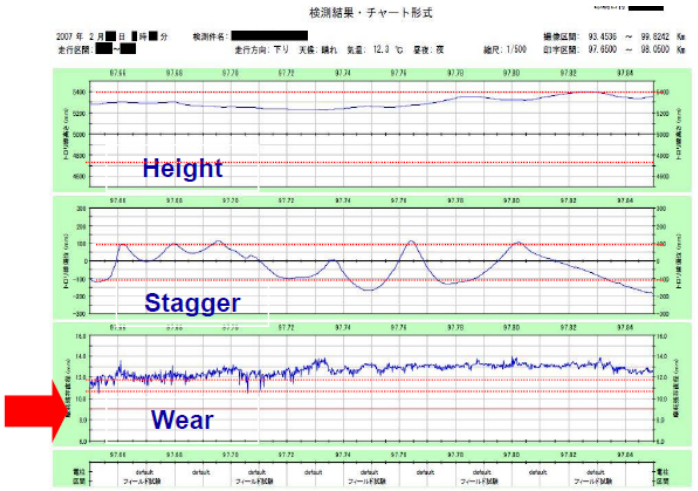
- UV/ IR camera for arcing and temperature monitoring
- Real-time alert and video playback



Temperature monitoring



Arc flash monitoring

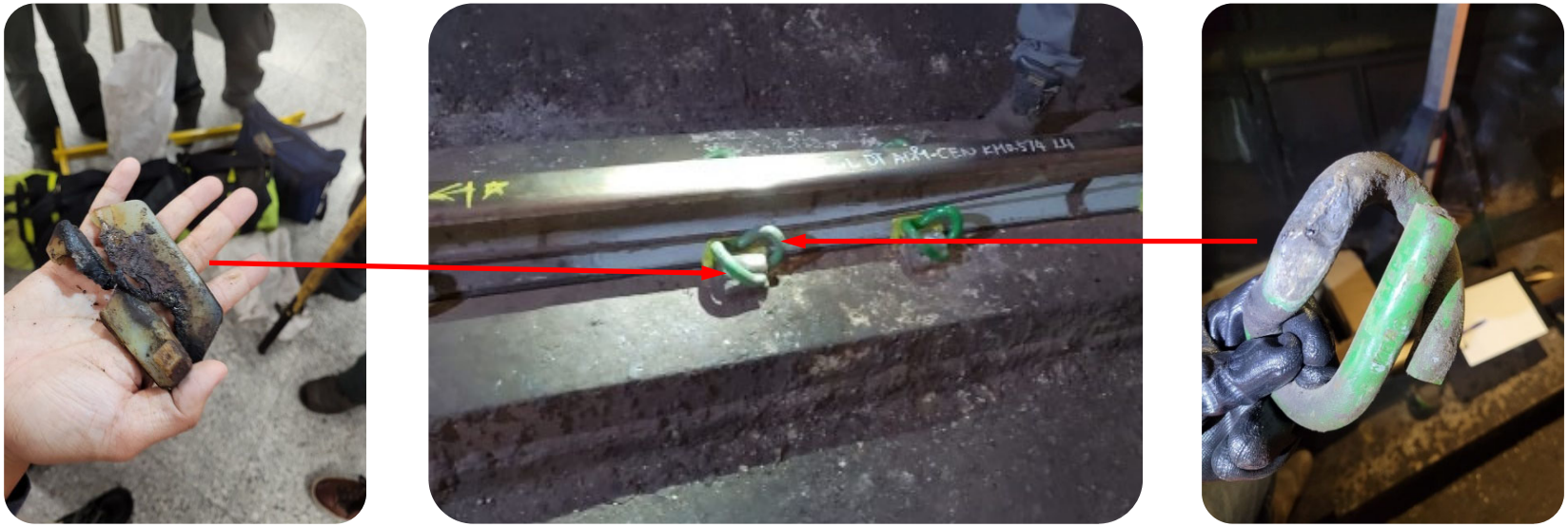


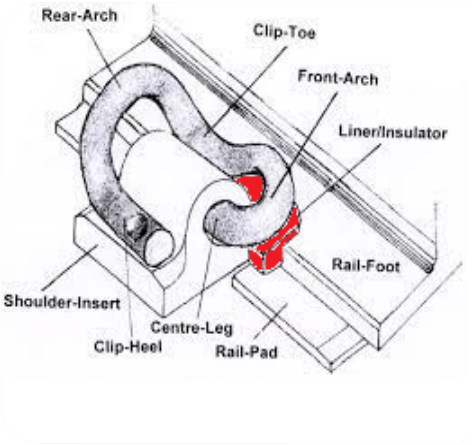
Railways EMSD

Stray Current Monitoring

Problem

- Stray current speeds up corrosion of equipment



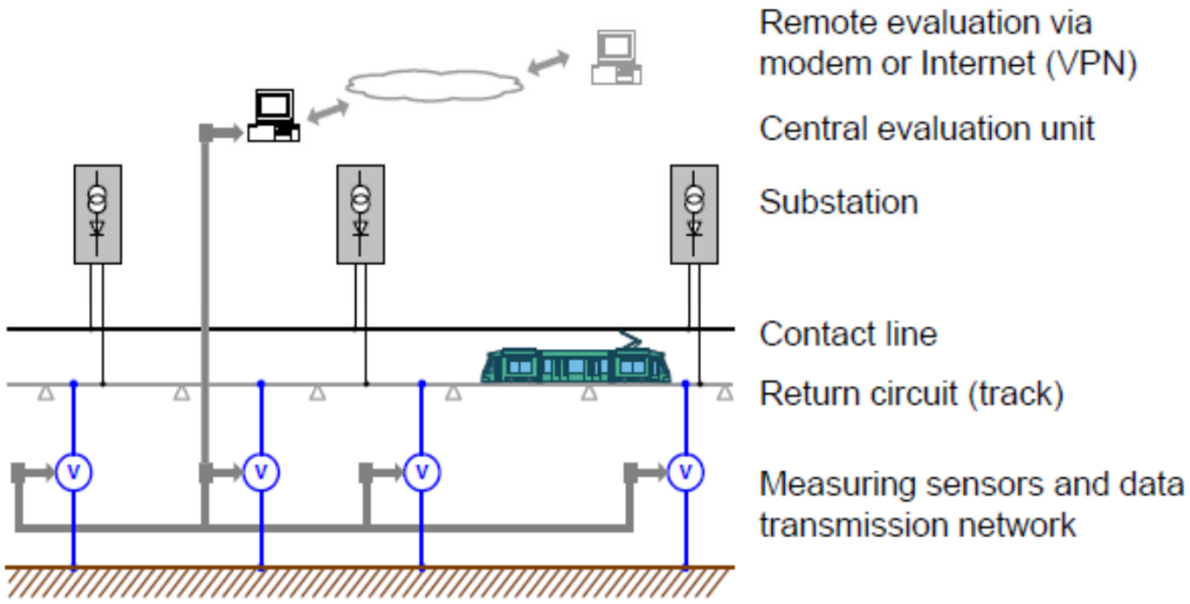


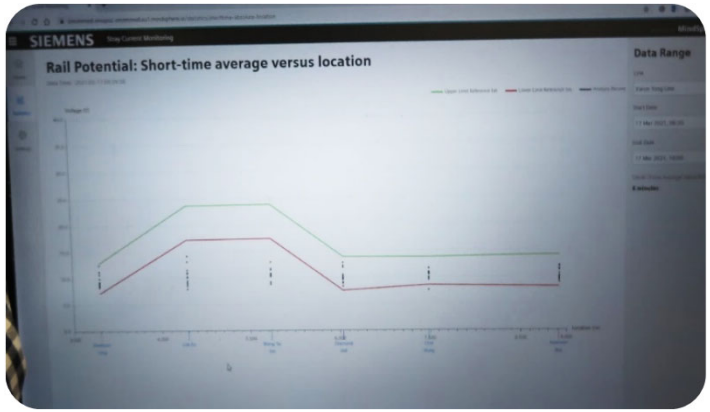
Damaged Clip

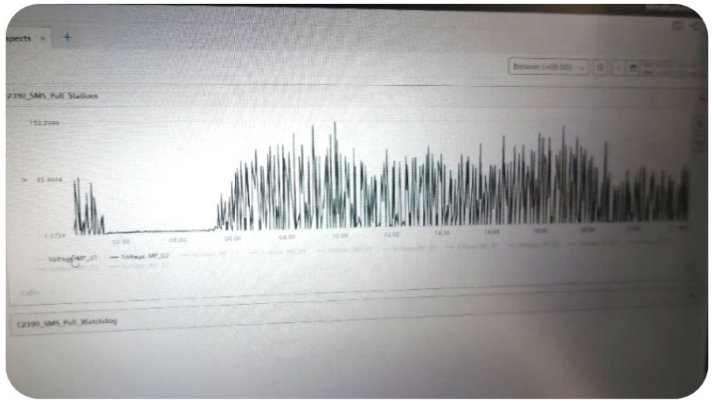
Stray Current Monitoring

Solution

- Voltage-based monitoring system for monitoring current trend





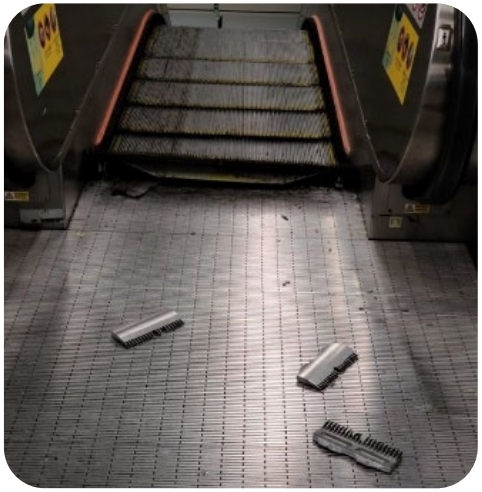


Railways EMSD

Escalators Safety

Problem

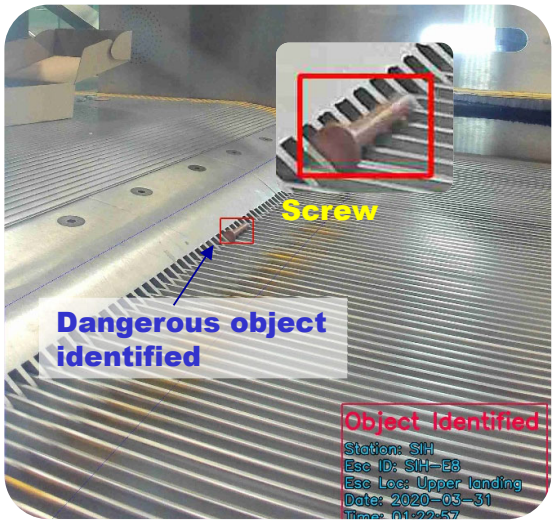
- Escalator step misalignment



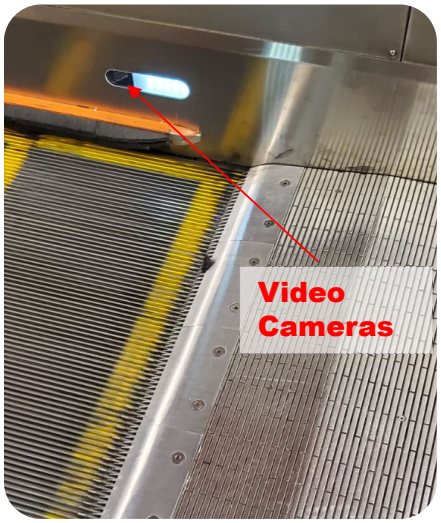
Escalator Comb Object Identification System

Solution

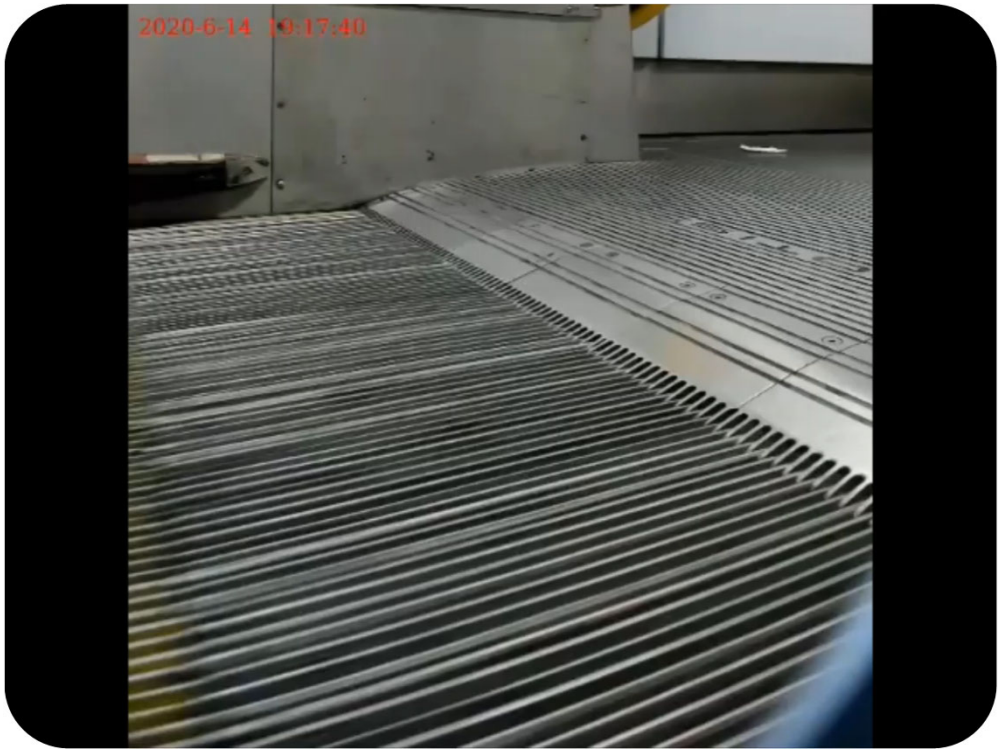
- Automatic detection system with video analytics
- Issue alert message to station staff



Objects detected by system



Cameras on skirt panels



Real Case Demonstration

Interactive Safety Training for O&M Staff

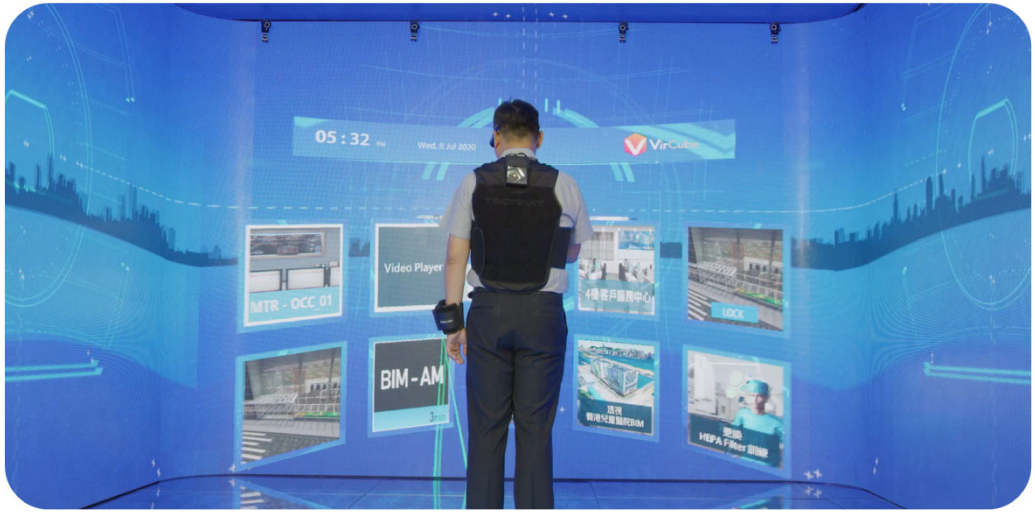
Problem

- Incidents caused by human errors

Solution

- Haptic and VR technologies to enhance staff training

Haptic and VR technology



Real Case Demonstration

On-going I&T Applications

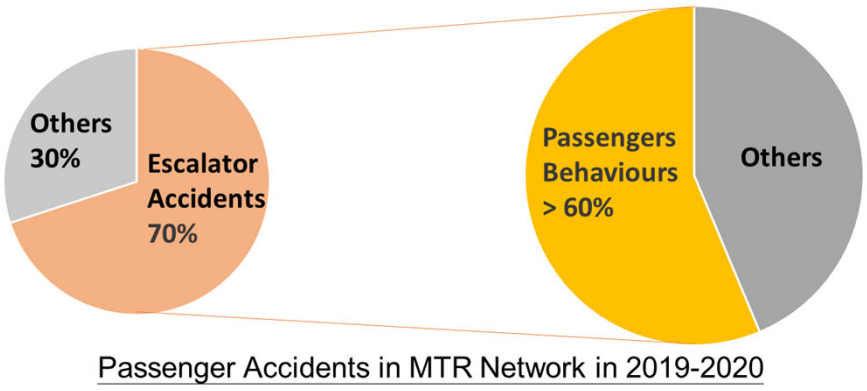
Projects include:

- Station - Escalator accident prevention system
- Tramway - Obstacle detection
- Driver - Smart alert device for Automated People Mover (APM)

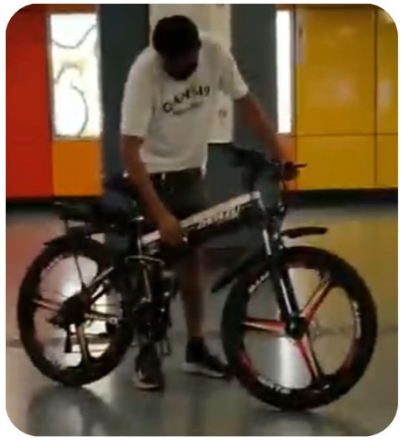
Escalators Safety in Station

Problems

- Passenger behaviors
  - Carrying bulky objects or baby trolley;
  - Influence by alcohol/ drugs;
  - Passengers with accessible needs



Passenger Accidents in MTR Network in 2019-2020

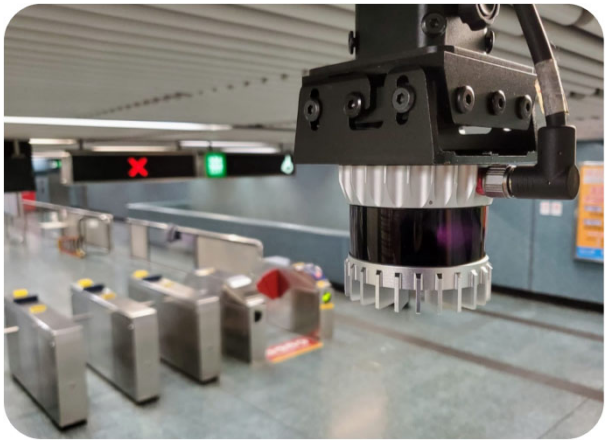


Railways EMSD

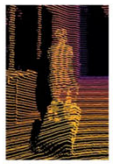
Escalators Accident Prevention System

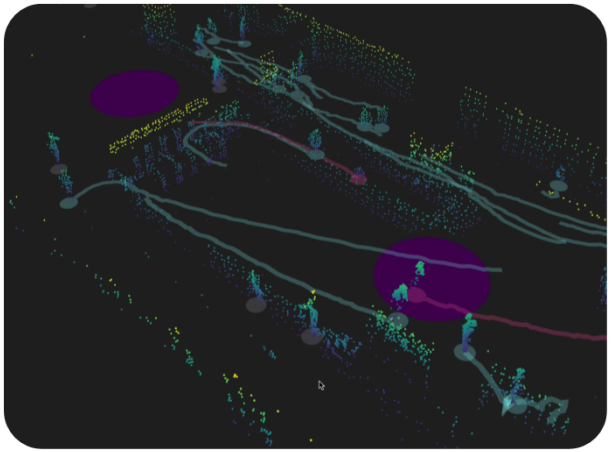
Solution

- Light Detection and Ranging (LiDAR)
- Privacy guarantee



Identify High-risk Passengers	Predict Passengers' Behavior	Trigger Alert
• Detect speed, volume profiling of passengers under crowd • Tracking path	• AI algorithm identifies characteristics of passengers • Predicts path	• initiate relevant PA & visual alert message • Instant message sent to station operators





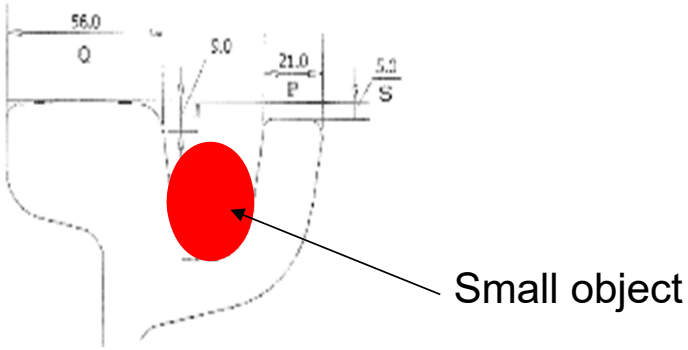
Object Detection on Tramway Track

Problem

- Small object trapped in rail

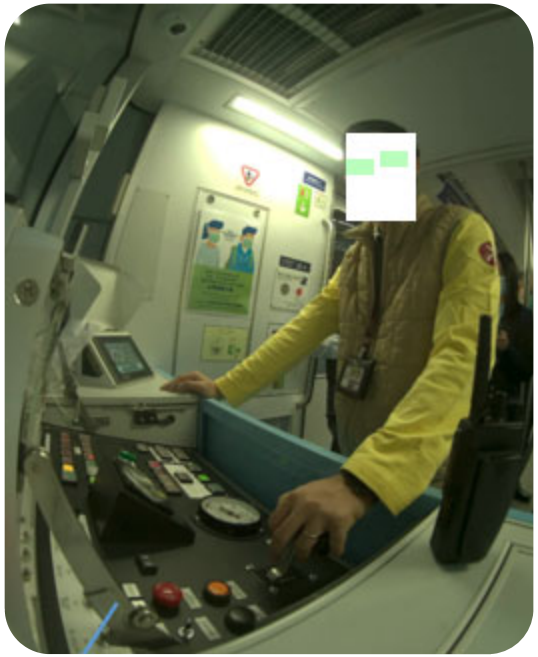
Solution

- LiDAR & video analytics with AI
- Real-time alert to tram driver



Smart Alert Device for Automated People Mover (APM)

- Smart alert device for drivers



Planned I&T Applications

Other projects:

- Smart Railway Intrusion Detection
- Smart Inspection of Railway Infrastructure Condition
- Smart Submission Approval Process
- AI Analysis for Prediction of P-way Incident

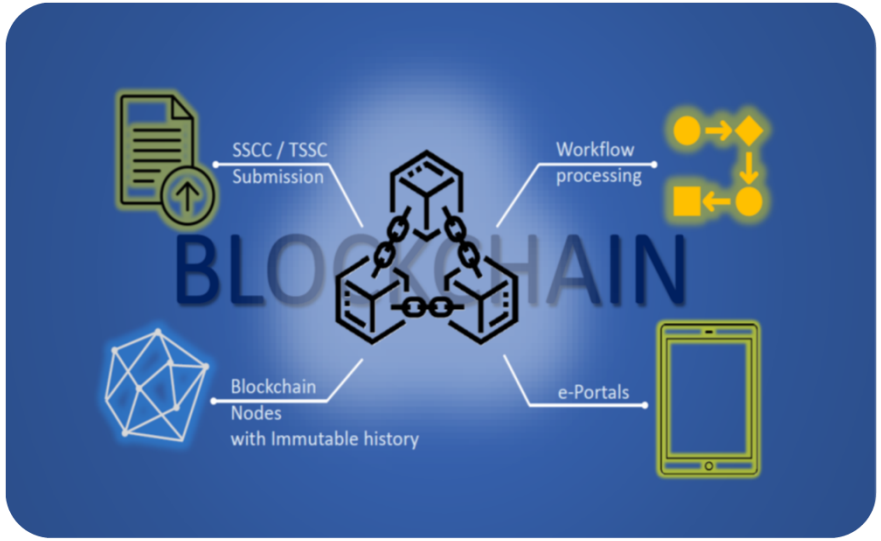
Smart Submission Approval Process

Problems

- Security issues in document flows

Solution

- Blockchain technology
- Digital authentication and electronic signature
- Enhance the security of document and workflow transaction



AI Analysis for Prediction of P-way Incident

Problems

- No prediction on P-Way incidents

Solution

- Semantic AI
- Predict P-Way incidents from asset data, maintenance records, incident reports and real time condition measurement results

Conclusion

- Railway industry should take advantage of rapid development of I&T presented opportunities
- Committed to continue applying I&T in our regulatory work and collaborate with railway operators to enhance railway safety

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Thank You