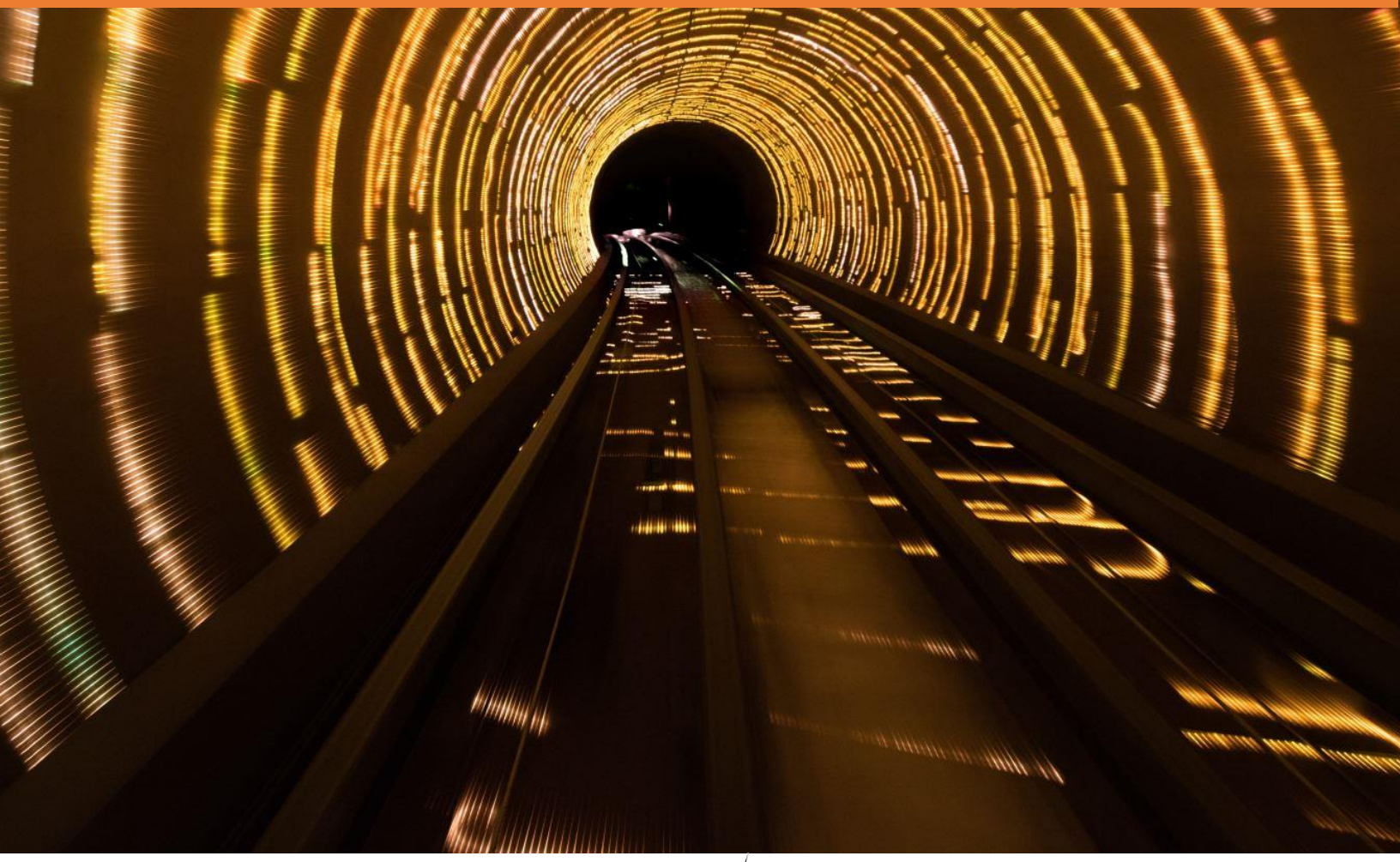
Smart Transportation Predictive Monitoring for Railways



AccreteSolutions
VISION. VALUE. DELIVERED.

3350 Scott Blvd, Bldg. 34 Santa Clara, CA 95054
Phone: +1 877-849-5838 www.acnsol.com

Sensors and IoT technologies that are implemented together with integrated security, asset management, and predictive maintenance are improving timely decision-making for issues like safety, scheduling, and system capacity. Smart railways represent a combination of interconnected technological solutions and integrated software solutions to optimize the usage of assets, from tracks to trains.

Large assets in Railways require frequent health monitoring. These assets can be either train borne or along the tracks. Innovative sensors, new communication technologies allied to cloud-based platforms have made it easy to implement predictive maintenance. Continuously monitoring trains and trackside infrastructure with the sensors and cloud-based platforms allow for predictive maintenance and improved operational efficiency.

Smart connected sensors allow for real-time monitoring of everything from rail deflection to actuators and even door mechanisms and can be used to forecast deterioration and suggest preventative maintenance measures. Below is an illustration of areas where IoT usage can deployed:

- Use of sensors by mounting them on tracks to monitor the track conditions. The sensors on the track can collect data on the track stress, track conditions, temperatures, and other variables.
- Monitoring of failure-prone systems on locomotives, such as the engine or electrical systems can increase the reliability significantly
- Monitoring of train doors to see if they are properly closed.
- Monitoring the speed of trains by GPS-driven speed measurements.
- Force detectors placed on a track to watch for flat spots as a train passes overhead
- Thermal detectors to spot a hot wheel caused by friction from brakes not releasing and dragging
- Monitoring of bridges regarding material stress or dynamic behavior to detect changes indicating future failure

Sensors are available to measure various properties including, but not limited to, speed, position, vibration, pressure, and liquid level. Sensors and devices can be classified into six main categories according to the measured quantify. The below figure illustrates six categories.

Measurement	Sensor Family
Displacement	• Displacement • FBG • Inclinometer • Optical
Temperature	• Thermocouple
Acceleration	• Gyroscope • Accelerometer
Current / Voltage	• Magneto Elec • Voltage
Stress / Force	• Strain Gauges • Ultrasonic
Pressure	• Piezometer
Fatigue / Crack	• Acoustic Emission

The below tables illustrate the use cases of these sensors for the fixed assets and rolling assets for railways.

Asset / Sensor Type	Displacement	Temperature	Acceleration	Current Voltage	Stress / Force	Pressure	Fatigue / Crack
Bridge	X		X		X		X
Tunnel	X					X	
Track	X	X	X		X		X
Rail bed	X	X				X	
Track Infra		X		X	X	X	

Use Cases for Fixed Assets

Asset / Sensor Type	Displacement	Temperature	Acceleration	Current Voltage	Stress / Force	Pressure	Fatigue / Crack
Train Shell		X	X		X		X
Wagon	X	X	X				
Bogies		X	X				
Axles		X	X		X		
Wheels	X	X	X	X	X		X
Brakes						X	
Pantograph	X	X	X	X	X		

Use Cases for Rolling Stocks

Converting data from sensors into insights and utilizing for predictive maintenance is the game changing concept. Predictive maintenance combines condition-based diagnostics (measuring vibrations, temperature, and other variables that have a predictable pattern) with complex predictive formulas to exactly predict when a piece of equipment might fail.

Our IoT Platform is managing 6+ million devices connected to 200+ command centers generating 22+ million records per day for Railways. The platform works seamlessly to integrate within existing day-to-day processes, offering advanced failure prediction while processing data in an automatic, scalable way and storing it in a secure cloud

environment. Let us take a closer look at deployment of our IoT platform for a Point Machine.

A Point Machine is an essential piece for railroad operation, a failure in the device can interrupt the operation for significant time causing significant delays. A Point Machine works with an electric motor that moves the switch blade from one side to another. When the device starts not working properly, there is an increase in overall friction of the system and that can be detected from the changes in current vs. time profile for the electric motor. By this signal technician can reduce the down time of the point in case of failure as the failure state is already made available by the system. The IoT Platform can easily capture signature failure and use machine learning to classify and predict them.

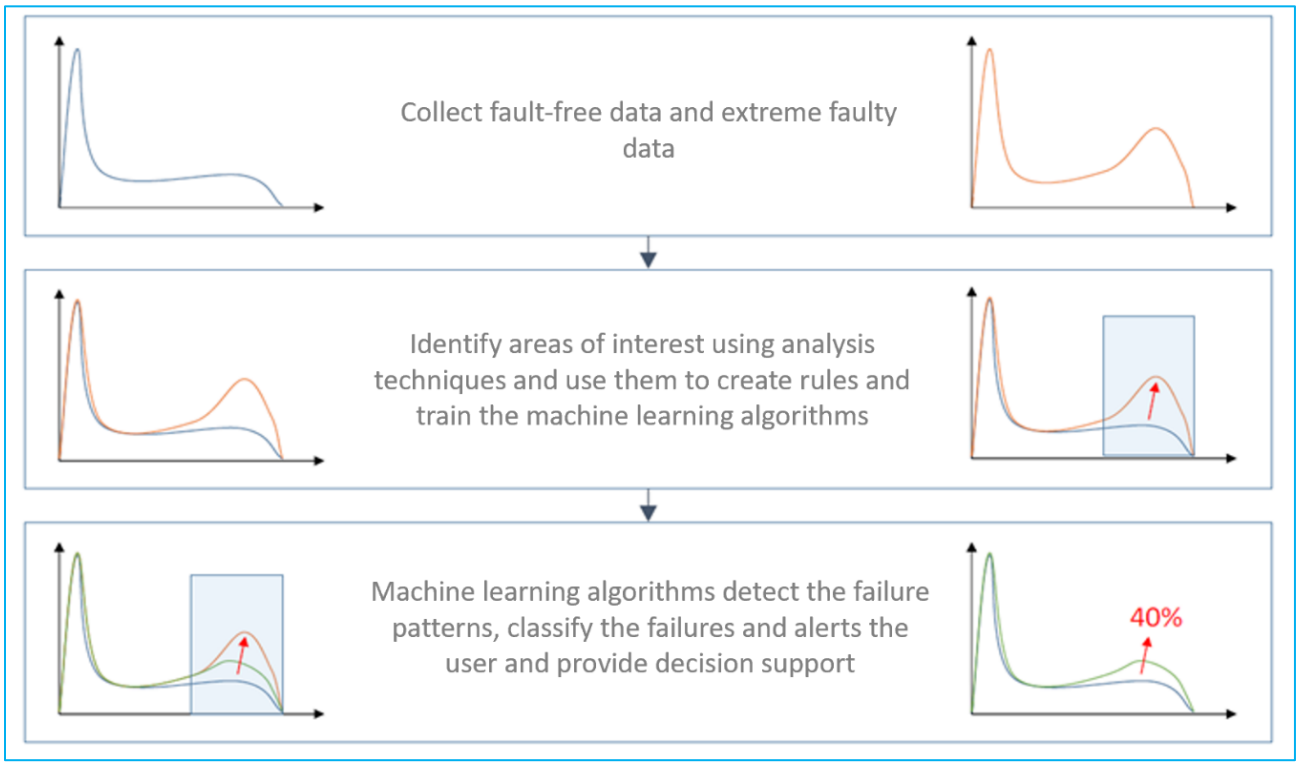


Illustration of Point Machine current measurement and predicting failures

Using connected IoT sensors, historic data and analytics, the data can be turned into useful information for predictive maintenance to improve asset utilization and availability.