

China Fast Train Safety System

Unlike medical doctors and medical devices that can help people one at a time engineering innovation can save hundreds, thousands or even millions of lives at one time. This is the nature of the Safety System that has been implemented by iOmniscient for the China Very Fast Train Project.

The challenge with very fast trains is that the driver has limited line of sight. By the time he sees a large obstruction in front of him (whether it is a truck or a fallen tree) he has insufficient time to stop the train. The plan was to place cameras along the track to detect obstructions and warn the drivers before they could actually see the obstruction themselves.

iOmniscient won the project as none of its competitors could eliminate false alarms which was critical to the operation of the system. This it did with its unique Artificial Intelligence based Nuisance Alarm Minimization System (NAMS).

Despite delays in decision making (because of their rigorous selection process) the project was completed well ahead of schedule enabling China Rail to launch their first long distance fast train on Boxing Day 2009. To date the system has run flawlessly without a single fatality.

On Boxing Day (26th December) 2009 the World's Fastest Train made its maiden commercial journey. With an investment of 1166 billion RMB, this rail line covers a distance of 1.068 kms with trains running at an average speed of 350 kms per hour. This compares with the 243 kms per hour in Japan and the 277 kms per hour averaged in France. In test runs the Chinese Train achieved 394 kms per hour.

The distance between Wuhan in Central China to Guangzhou in the country's south was covered by the high-speed train in two hours forty-five minutes and this train therefore cut the travel time between these two cities by more than six hours. Wuhan is a primary Yangtze River port and a major industrial center. Guanghzhou is the export powerhouse of China.

The Very Fast Train Project implemented by China Rail faced many challenges. Fast tracked as part of the Chinese Government's stimulus package in the face of the Global Financial Crisis, the management was acutely aware that they had to minimize risk on this extremely prestigious project. They could not afford any fatal derailments. The last thing they needed was an incident where international passengers were hurt or killed in an accident involving this train.

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The Problem

With very fast trains if there is an obstruction on the track, by the time the driver sees it, it is too late. The driver may only have line of sight for a limited distance in front of him – usually no more than 700m. The train can take up to 5 kilometres to come to a halt. Allowing for the driver's reaction time the stopping distance can be longer.

While every precaution had been taken to prevent humans, animals and vehicles from trespassing on the track it was recognized that it was still possible that the track could be obstructed on purpose or by accident. The Chinese Ministry of Railways (MOR), keen to ensure that they would have a flawless track record with respect to derailments and accidents, decided to use AI based Computer Vision to detect people or objects that might intrude on to the track.

With 42 more Fast Train lines scheduled to become operational within a few years it was very important for the reputation of the railways that they had a record of zero accidents.

In completing the 1000 km railway line they found that there were many points at vehicles or people could access the track. There was a real risk that the train could encounter a large object such as a truck. The problem was aggravated by the fact that people in the countryside were not very disciplined and they regularly drove their trucks and cars onto and across the track even when they were not authorized to do so. They were known to bring their tractors and park them close to the track not realizing the danger when a train passed by.

Every effort was made to eliminate risks by educating people living near the track and creating barriers where possible and creating bypasses but the danger still remained.

The obstructions could also be accidental. A rock fall at the mouth of a tunnel or a fallen tree could be as hazardous to the fast train as a truck. The potential financial cost of an accident on the track was enormous. Worse still was the cost to China Rail's reputation if such an accident were to happen. The plan was to install video cameras at all critical locations where the track could be intruded upon or where there was a risk of an accidental natural obstruction. Without a solution to this problem the train service could not be launched.

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The train travelled through very diverse country side. It passed through mountains and valleys, deserts and jungles, sparse open spaces and dense urban areas. In a video based intelligent surveillance system there are many factors that can cause false alarms. The most significant cause of false alarms are light variations which can cause shadows or shards of light which can be mistaken for objects in the two dimensional view of the camera. Small animals, swaying trees, moving clouds and many other natural phenomenon can also cause false alarms.

While the MOR was keen to avoid accidents it was equally important to them that the train would not be slowed down or stopped unnecessarily. If there were false alarms every few minutes the train would never achieve its target speed. The whole project was at risk of being delayed or aborted if the issue of safety could not be resolved.

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The Solution from iOmniscient

The Chinese Ministry of Railways finally selected iOmniscient because:

- It could detect objects intruding on the track with very high accuracy.
- It operated with virtually zero false alarms.
- It had a HealthCheck system that could advise them immediately if any of these remote cameras was not functioning properly.

The driver receives images of the obstruction and has sufficient time to acknowledge the alarm. If he does not react within the required time frame, the system automatically slows down and stops the train.

The safety system for the Fast Train is one component of IQ-Rail, a comprehensive system for enhancing Safety and Security for railways and increasing productivity for its staff.

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