SAMIRA2.0

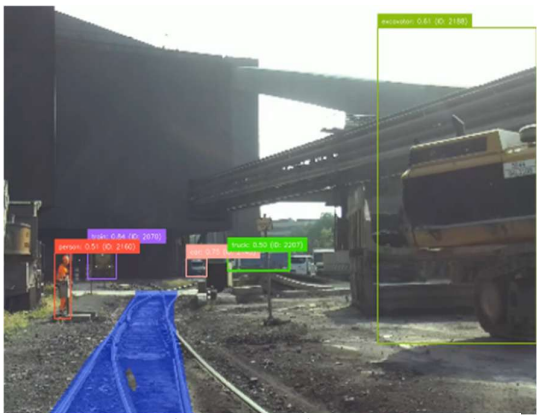
The Assistance System for Pushed Shunting Units

The SAMIRA2.0 (**S**hunting **A**ssistant & **M**onitoring **I**nterface for Autonomous **R**ail **A**pplications) research project is a collaboration between Ikado GmbH, Aachen, Chemnitz University of Technology, and Ensytec GmbH, Haltern, to develop an assistance system for pushed shunting operations. The SAMIRA2.0 project is funded by the Federal Ministry of Transport (BMV) as part of the Federal Programme for the Future of Rail Freight Transport (Z-SGV).

An intelligent sensor module at the peak of the shunting unit detects and analyses the surroundings and identifies any obstacles and dangerous areas. This ensures safe shunting even without having a shunting attendant, and so the system additionally contributes significantly to reduce the acute shortage of personnel in the shunting area, too.

SAMIRAmobil w/ RADAR, LiDAR, Stereo camera, GNSS and 5G data transmission

The portable, battery-powered SAMIRA*mobile* sensor module, which can be easily and flexibly attached to the last wagon, contains an environment and obstacle detection system comprising a RADAR sensor, a laser scanner (LiDAR), a stereo video camera and an GNSS satellite navigation unit (GPS/GALILEO).

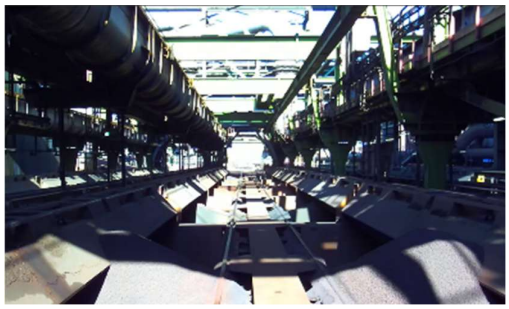


Augmented video stream displayed to the driver

During a push operation, a video stream is recorded at the peak of the shunting unit, transmitted in real time to the driver's cab of the engine where it is displayed to the driver on a screen (SAMIRA*hmi*). Augmented reality is used to highlight important features such as people located near the track, signalling, as well as distances and the actual train-speed. If the system detects obstacles on the track, the locomotive driver also receives calculated recommendations to break.

Measurements and test drives in industrial environments and AI training

Since the hardware has been developed already, extensive measurements and test runs are being carried out regularly under real conditions on the track system of thyssenkrupp Steel Europe AG in Duisburg, which supports the SAMIRA project as an associated partner. This enables the verification of correct data acquisition and its synchronous processing within the SAMIRA*mobil*e module. It also tests and confirms an error-free and seamless real-time transmission to the driver's cab in a harsh industrial environment. However, the shunting manoeuvres also provide – and this is just as important – real measured data for the continuous improvement of the environment and obstacle detection. Since this is an AI-based solution, the recorded video and sensor data is used in particular to train the software for all aspects of shunting scenarios, too, which pose extremely challenging conditions in terms of lighting and the harsh industrial environment (see photos).



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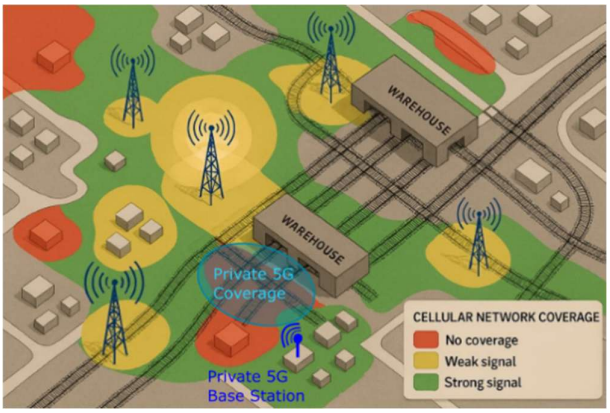
Wireless data transmission via a hybrid 5G mobile network

A key requirement for the safety and acceptance of the system is the secure, seamless and encrypted real-time transmission of the augmented video stream from the front of the pushed shunting unit to the driver's cab, which is carried out via the 5G mobile network in SAMIRA.

However, especially the conditions in the last mile, such as dense buildings, large machine structures or drive-through halls, poses a particular challenge for the transmission quality. For this reason, a new hybrid communication concept was developed for SAMIRA 2.0, which combines both, the public and the private 5G networks for a seamless signal transmission.

The integration of additional private 5G campus networks enables dedicated coverage of critical areas with high data rates and low latencies. In order to combine the advantages of both techniques, a multi-RAT (Radio Access Technology) system was implemented, which enables simultaneous connections to both networks. Additionally, a self-developed algorithm continuously monitors the signal quality and dynamically decides which network to use for data transmission.



Data transmission: 5G coverage w/ topographical shading

In order to gain further practical insights, the reliability and coverage of commercial networks and their suitability for the secure transmission of real-time video data within the last mile are being investigated, too.

Positioning and Digital Map

For the SAMIRA system, valid position determination with high accuracy is very important, as this determines, among other things, the exact track on which the shunting unit is located. In order to achieve the required precision and reliability even under harsh industrial conditions, the absolute position is calculated using satellite navigation signals (Galileo, GPS) and a digital track map.

The SAMIRA2.0 Project Partners

Ikado GmbH in Aachen is leading the project and developing all of the software for object and obstacle detection using its own customised AI algorithms and position determination. After the system modules have been assembled, Ikado performs system integration and initial operation.

Chemnitz University of Technology conducts the practical train runs for real-world tests and measurements of the 5G hybrid operation on its digital 5G test field of the Erzgebirgsbahn at the Smart Rail Connectivity Campus (SRCC) between Annaberg-Buchholz and Schwarzenberg.

Ensytec GmbH in Haltern am See designs and manufactures the housing for the SAMIRA*mobil* module. This also includes the power supply and the exchangeable battery, as well as quick and flexible fixing to the last wagon using a specially developed quick-release fastener.

Thyssenkrupp Steel Europe AG, Duisburg, as an associated partner, facilitates extensive measurement and test runs under real conditions on the harsh industrial track system at its site in Duisburg.

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