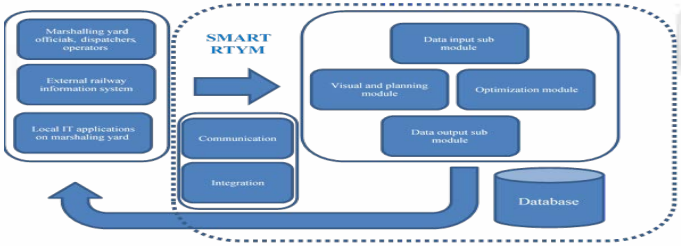
Executive Summary

The SMART project responds to the 1st Open Call issued by the Shift2Rail Joint Undertaking, as part of Shift2Rail H2020 programme. It addresses the topic S2R-OC-IP5-01-2015: Freight Automation on lines and in yards. The project main goal is to contribute to automation of railway cargo haul at European railways by developing of two prototypes: an autonomous Obstacle Detection (OD), and a real-time yard management (RTYM).

SMART RTYM system provides optimization of available resources and planning of marshaling operations in order to decrease overall transport time and costs associated with cargo handling.



SMART RTYM system is a web-based information system developed to visually represent the marshaling yard configuration, provide manual or automated input of inbound and outbound train parameters, as well as planning of wagons sorting (marshaling). The information system is able to export data to other systems.

Main testing of SMART RTYM has been done on data provided from MY Niš, Serbia. Additionally, database of European marshaling yards has been created. (MYs from Germany, Sweden, Bulgaria and Serbia) .

Consortium

University of Bremen, Germany
University of Niš, Serbia
Harder Digital Sova, Serbia
Technical University of Sofia, Bulgaria
RWTH Aachen University, Germany

Smart

SMart Automation of Rail Transport

Real-time Yard Management System

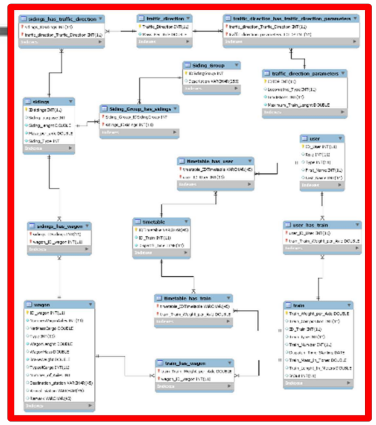
www.smartrail-automation-project.net

Shift2Rail

Horizon 2020
European Union Funding for Research & Innovation

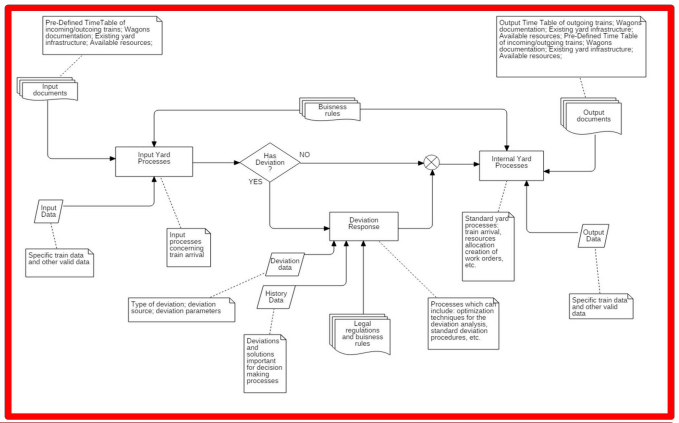
Analysis of marshaling yards

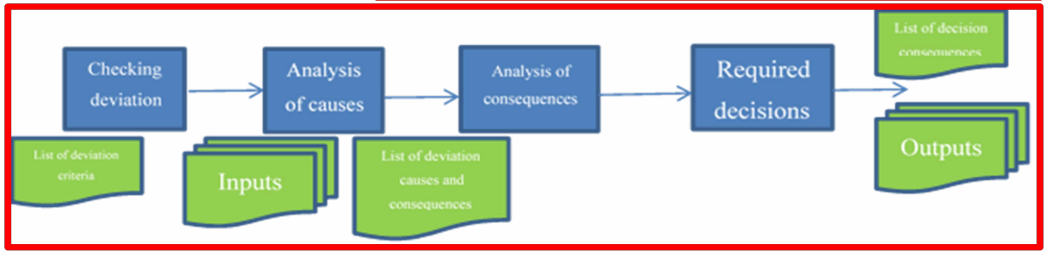
SMART machine learning models were trained so to classify different classes of objects, possible obstacles on the rail tracks, such as humans, animals and vehicles.

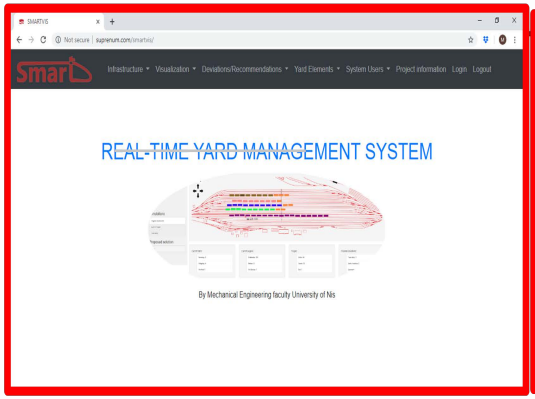


Modeling marshaling processes

Numerous static and two dynamic real-world field tests were conducted. During the dynamic field tests in July 2018 and May 2019, the SMART OD system was mounted onto the locomotive pulling the 21 wagons on the Serbian part of the Pan European corridor X to Thessaloniki in length of 120 km. During the train run, onboard sensors recorded the data of the real-life rail tracks scenes in front of the locomotive.

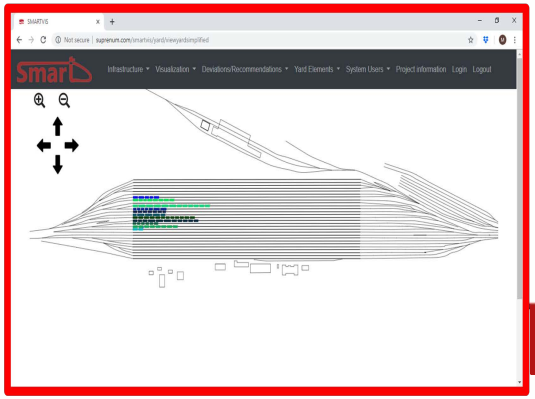






Database of European marshaling yards

In order to decrease the negative influence of vehicle‘s vibration to the quality of camera‘s images, the passive vibration suppression system was designed.
The designed system significantly



SMart

SMart Automation of Rail Transport

Long-range obstacle detection

Using the novel machine learning based SMART methods for obstacle detection and distance estimation, reliable mid (about 200 m) and long (up to 1000 m) range obstacle detection was achieved.

For ground truth of 835 m (RGB image) and 225 m (Night vision image) following estimation result was obtained:

Object	RGB Camera (top)	Night vision camera (bottom)
ersn 1	8[illegible]99 m	225.[illegible]3 m
	[illegible]0.57 m	237.23 m

Distance estimation from multiple cameras

A sensor fusion method was developed, which was based on a novel multilayer neural network that learns the relationship between the object distance and the sizes of the object in both camera images. For RGB and Thermal cameras following estimation was obtained:

Sensor fusion

Frames	1 (left)	2 (right)
Estimated distance	160.92 m	141.80 m