SAFER-LC

WP3: development and Integration of technical solutions

WP Leader: NTNU
Objectives

The aim of this work package is to develop technological solutions to improve safety at level crossings as well as at working zones through:

- sharing information and giving warnings to trains/vehicles approaching/arriving to level crossings and to workers at or near train passing zones.
Objectives

A lot of existing technologies in terms of detection, recognition, data exchange and communication

Idea is to test already existing technologies to demonstrate the feasibility and the usefulness of technological bricks
To develop **technological solutions** to **improve safety** at level crossings as well as at working zones through **sharing information** and **giving warnings** to trains/vehicles approaching/arriving to level crossings and to workers at or near train passing zones.
## Tasks and Involved Partners

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<td>CEREMA, DLR, NTNU, CERTH, COMM, UIC, INTADER</td>
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<td>Task 3.2 – Smart detection system</td>
<td>CEREMA</td>
<td>UTBM, COMM, VTT, NTNU, IFSTTAR, CERTH, UIC, SNCF, NeoGLS, INTADER</td>
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<td>Task 3.4 – Communication systems for cross-modal information sharing</td>
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<td>VTT, COMM, NeoGLS, NTNU, CEREMA, CERTH, SNCF, TRAINOSE</td>
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Risk evaluation (UTBM)

- Provide a component of SAFER-LC Toolkit with off-line semi-automatic and fully-automatic risk assessment
- Identifying and understanding the dynamics of hazardous situations in LC environments
- Extraction and description of dangerous behaviour models of user-to-user and user-to-infrastructure (LC) interactions
- Extracting quantitative information (number of occurrences of each dangerous behavior or interaction and classification)
Methodology

Two main steps

1. Knowledge extraction from video data
   ▲ Scene semantic segmentation (Machine learning / deep learning, background subtraction techniques)
     ▲ Users detection and recognition
     ▲ Infrastructure objects recognition
     ▲ Barriers state recognition
   ▲ Users trajectory extraction (objects tracking, matching, optical flow)

2. Abnormal situations classification and user behavioural modeling
   ▲ Sequence segmentation (detection of state changing / important moment detection)
   ▲ Analysis of the targets (vehicle, truck, pedestrian, etc.) involved in each detected subsequence
   ▲ Classification of abnormal situations into different pre-defined models (zigzagging, obstacle, stopped vehicles line, etc.)
Use cases:

- Zigzagging
- Illegal intersection crossing
- Wrong way crossing detection
- Stop detection
Work done and Results achieved

- A simulator is developed to generate realistic looking videos
- High resolution video rendering framework is complete
  - It will allow vehicle detection and tracking, barrier angle detection, and traffic light signal detection
- The simulator has been improved
  - with new vehicle dynamics model enables to simulate trucks
  - improved tire friction model to simulate different scene
Smart detection system (Cerema)

- **Dynamically detect** any abnormal behaviour of road/vulnerable users and detect/identify obstacles (e.g. stopping vehicles) that may be the potential source of an incident at a LC, by monitoring the LC environment and its surroundings, to reduce the risk of collisions and near misses at LCs.
Use cases
- Cars stopped processing time
- Pedestrians
- Atypical behaviour
- Traffic jam

Indicators: detection performance, recognition performance, processing time

84% of good detection

Smart detection system interface
3.4 : **Communication systems for cross-modal information sharing (Ifsttar)**

**Specific objectives**

- Develop systems to transmit and share the risks and hazard information detected at LCs
- V2X-based sensing, actuation and information sharing techniques to detect and forecast train arrivals and broadcast
Work done and results achieved

▲ Definition of evaluation method
▲ Definition of evaluation indicators: Packet Delivery Ratio PDR, Effective Communication Range, Transmission delay
▲ Three scenarios were studied:
   ▲ traffic jams occur at the level crossing with barriers open
   ▲ slow crossing of an old pedestrian with barriers closed
   ▲ case where a car is blocked between the barriers

Range: 300 m in Aachen test site
3.3 Infrastructure Monitoring and remote maintenance

I. To develop a real-time monitoring system of LCs using vibration sensors
   • To monitor the vibration on track/road components due to dynamic loading
   • To set an alert threshold to assess the status of the LC components
   • To send alerts to LC owners and maintainers of possible safety risks

II. To monitor and assess the condition of LC infrastructure to ensure the safety performance of the LC
   • To identify and predict the potential failures at LC boom barrier
   • To send alerts of possible safety risks due to LC infrastructure faulty operations

Train loading

Car tyre loading
Methodology

△ Two approaches will be followed for the real time monitoring
1. Photogrammetric method: Measure displacements to monitor infrastructure surface condition
△ → complemented with thermal-infrared measure to detect road fissures
2. Vibration method: Measure accelerations to assess the LC components status and set alert thresholds
Work done and results achieved

- A test site and test configuration is developed
- Mock tests of the photogrammetric method is conducted to detect the movement and displacement of elements
Status of WP3

- Completed end of October 2019
- Deliverables:

  D3.1  Proof-of-concept on data acquisition platform for risk evaluation and AID systems  M15
  D3.2  Report on communication and warning system  M24
  D3.3  Guidelines for installation of smart sensors for monitoring of LC infrastructure  M24
  D3.4  Report on risk evaluation system and use cases for pilot test  M30
  D3.5  Report on smart detection system  M30
Global recommendations

WP3

- is a technical workpackage
- Demonstrators are small scales ones and in protected areas
- The datasets collected are quite reduced

Results on the different demonstrators are quite promising

- Risk evaluation is a very good tool to generate many use cases
- Smart detection system shows the technical feasability of a video-based sytem
- Communication tools shows also the complementarity between detection and communication
- Infra monitoring and remote maintenance is a good predictive system for failures

Recommendations

- Test the implemented measures in a larger scale real world experiments with well-planned research design to obtain more information on their effects
- Analysis of user behaviour and on road safety
Thank you for your attention