



Horizon 2020
European Union Funding
for Research & Innovation

WP3: Artificial intelligence for predictive maintenance and defect detection

A PoC on Smart Maintenance at Level Crossings

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Railway Problem and Motivation



Objective of the PoC

Investigate potential of:

- AI for Smart Maintenance at Level Crossing
- Simulators for Synthetic Data Generation

Constraints / Requirements

Non-Intrusive Sensors
Cost-Effectiveness

Main Issues and Challenges

Data Availability
Data Labelling

Key Performance Indicators

Implementability Costs
Computation Time
Effectiveness

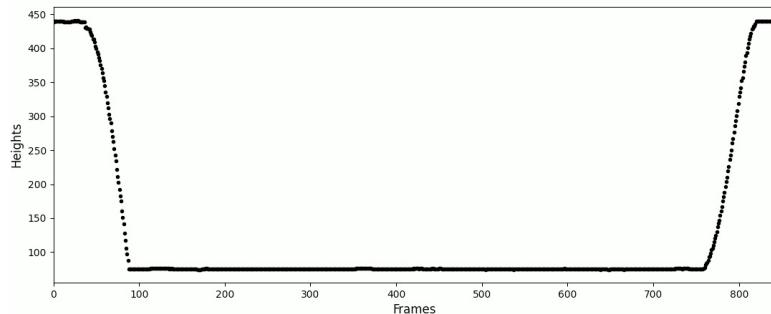


Image taken from GTA V.

Proof-of-Concept as a Benchmark



AI Application
Computer Vision

AI Techniques
Deep Learning
Audio Classification
Object Detection
Transfer Learning

Inspiring Solutions
Research on AudioSet
Studies exploiting GTA V



Datasets

AudioSet, YouTube
Synthetic Data from GTA V



Developments / Implementations

VGG-ish based Audio Classifier
YOLOv5

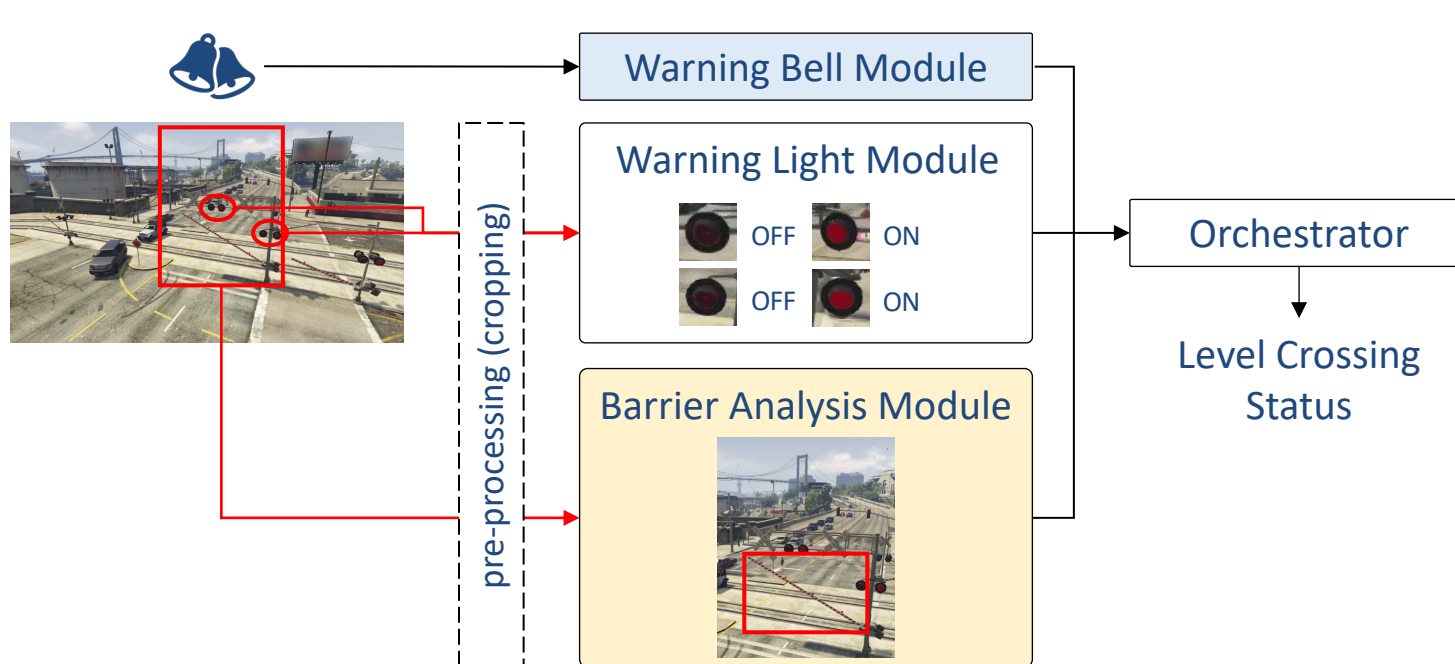
Exploited Software and Framework

YouTube, GTA V
PyTorch, Keras

Hardware Requirements

GPU(s) with CUDA cores and
min 16GB RAM

Approach: A Modular Architecture



Warning Bell Module

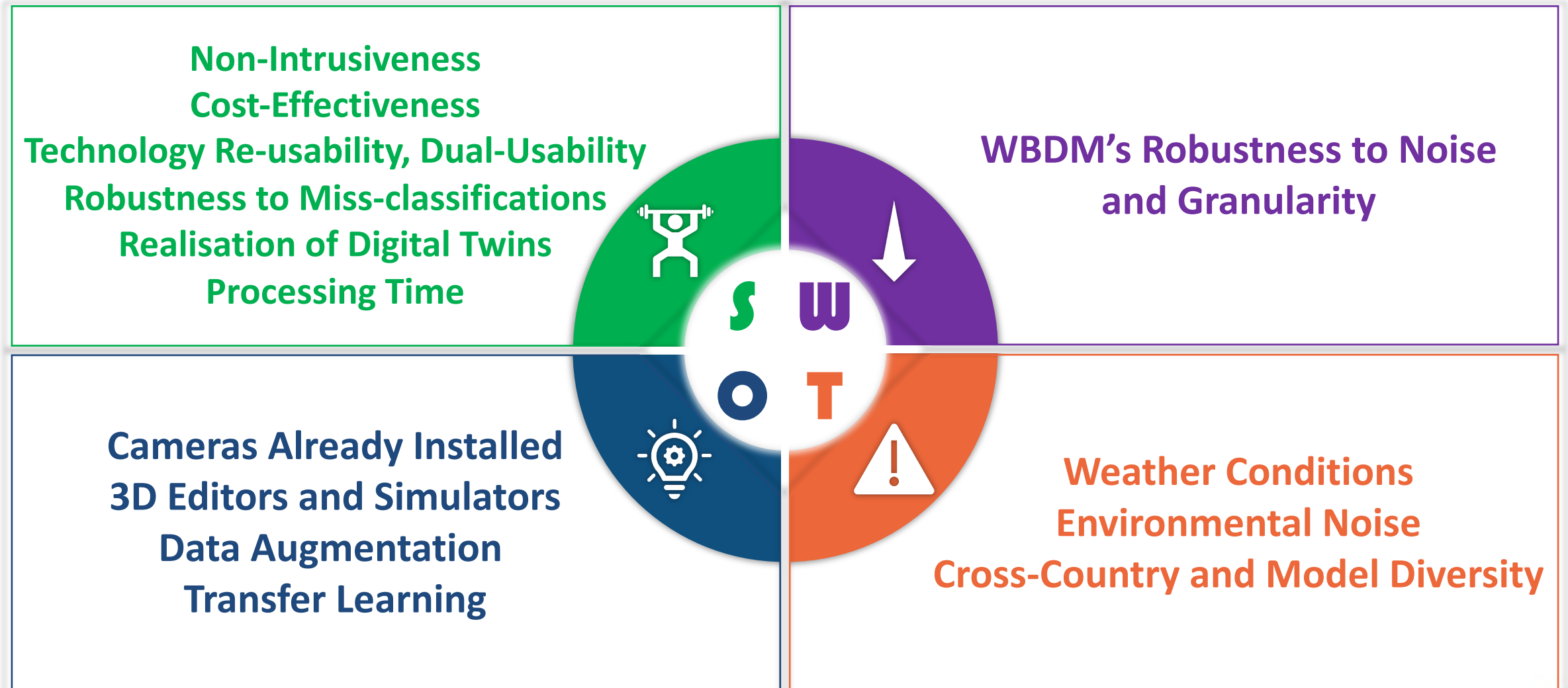
- Three-class Classification
- AudioSet / YouTube (1180 samples)
- VGGish CNN
- VGGish's weights (on YouTube8M)
- Frame-Level Accuracy: 92.48%
- Audio-Level Accuracy: 97.37%
- 1.13 ms

Barrier Analysis Module

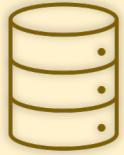
- Object -Detection
- GTA V + Augmentation (17760 samples)
- YOLOv5s
- YOLOv5s' pre-trained weights
- mAP@.5:.95: 0.98738
- Miss-detection Rate: < 0.8 %
- 10.36 ms

The line graph shows the height of the barrier over time (frames). The Y-axis is 'Height' (0 to 450) and the X-axis is 'Frames' (0 to 800). The TNC (red line) and CNC (blue line) methods are compared. The Top Threshold (430) and Bottom Threshold (83) are indicated. The CNC method shows a sharp drop in height around frame 100 and a sharp rise around frame 800, while the TNC method remains relatively flat.

SWOT Analysis of the Investigated Approach



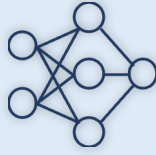
Main Recommendations for Vision-Based Obstacle Detection



**Exploit Real-life
Simulators
(and 3D Editors)**



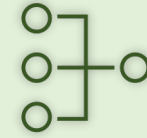
Quickly and Safely
generate data (for PoCs)



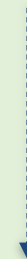
**Exploit Task-specific
Characteristics**



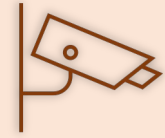
Facilitate Tasks for
AI Models



**Exploit Modularity
and Audio-Video data**



Facilitate Tasks, Improve
Robustness and
Applicability



**Exploit Existing
Sensors and
Dual-usability**



Cost-effectiveness,
Improve both
Maintenance and Safety

Thank you for your attention!



- ✓ *Deliverable D3.1: WP3 Report on case studies and analysis of transferability from other sectors (safety and automation)*
- ✓ *Deliverable D3.2: WP3 Report on AI approaches and models*
- ↻ *Deliverable D3.3: WP3 Report on experimentation, analysis, and discussion of results*
- ↻ *Deliverable D3.4: WP3 Report on identification of future innovation needs and recommendations for improvements*

Available at: <https://rails-project.eu/downloads/deliverables/>