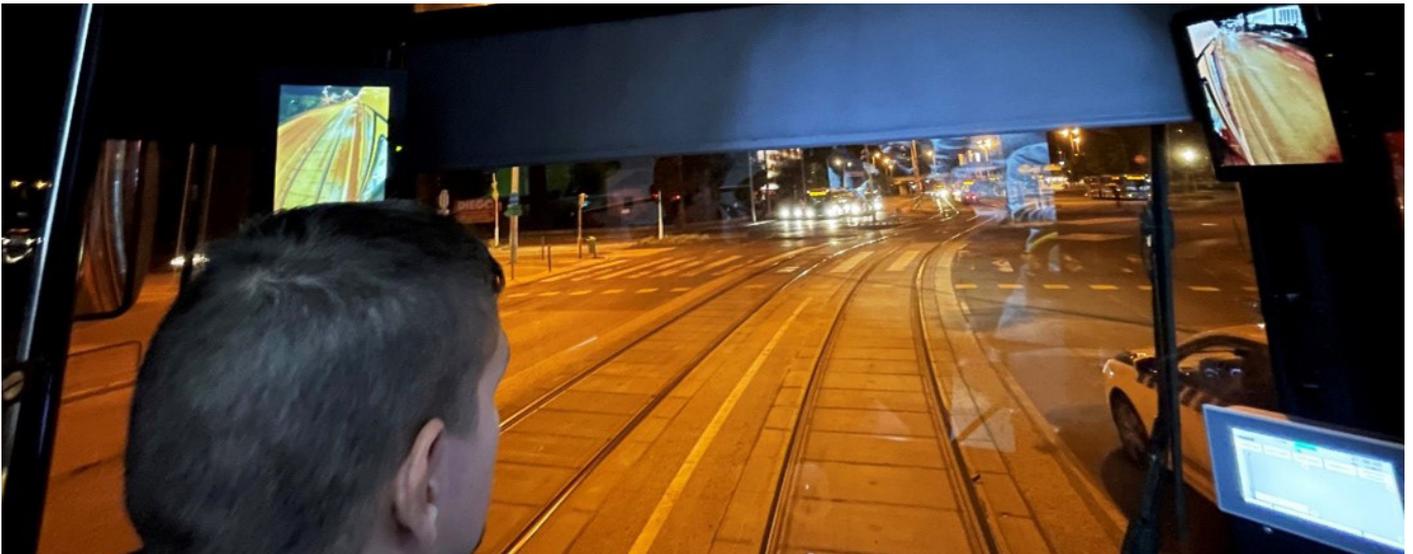


EYYES

More Safety for Railway Traffic with Artificial Intelligence



How do we make rail traffic safer? How do we avoid accidents with vulnerable road users?

EYYES GmbH has been asking itself these and many other questions about traffic safety for years. EYYES specialises in camera monitor systems and artificial intelligence for the rail sector, with locations in Austria and Germany.

It all started with the RailEye® as a replacement of the classic exterior mirror by an electronic camera monitoring system. RailEye® provides very good image quality and meets the highest safety requirements according to the SIL1 standard. This means that the images are transmitted to the driver without delay and

with an enlarged field of view to reduce the size of the blind spot. RailEye® consists of several high-resolution cameras and provides a better overall view of the vehicle's exterior. Particularly in heavy traffic, for example in the morning rush hour, the system can be a huge support for the railway driver. This system has just been selected by Albtal-Verkehrs-Gesellschaft mbH (AVG) and Verkehrsbetriebe (VBK) Karlsruhe for retrofitting on to existing vehicles, and it has already been in use for many years on Leipzig's trams.

Right at the spotlight are the new driving assistance solutions based on artificial intelligence with deep neural networks. With the Front Collision Assistant from EYYES, a new timeline is beginning here in the railroad. The system recognises

all road users and classifies objects precisely into vehicles, people and cyclists from close range up to a distance of 80m. Then it generates an image of the traffic situation in front of the vehicle and calculates the movement of all detected objects and relates it to the movement of the vehicle. This all happens continuously in a few milliseconds and thus almost in real time.

If an object is detected outside the defined danger zone, the system calculates a possible collision based on its movement vector and informs the driver. If the object remains on its path and enters the danger zone, the total time until the collision is continuously calculated and a warning is issued to the driver when the threshold value is achieved. The driver still has

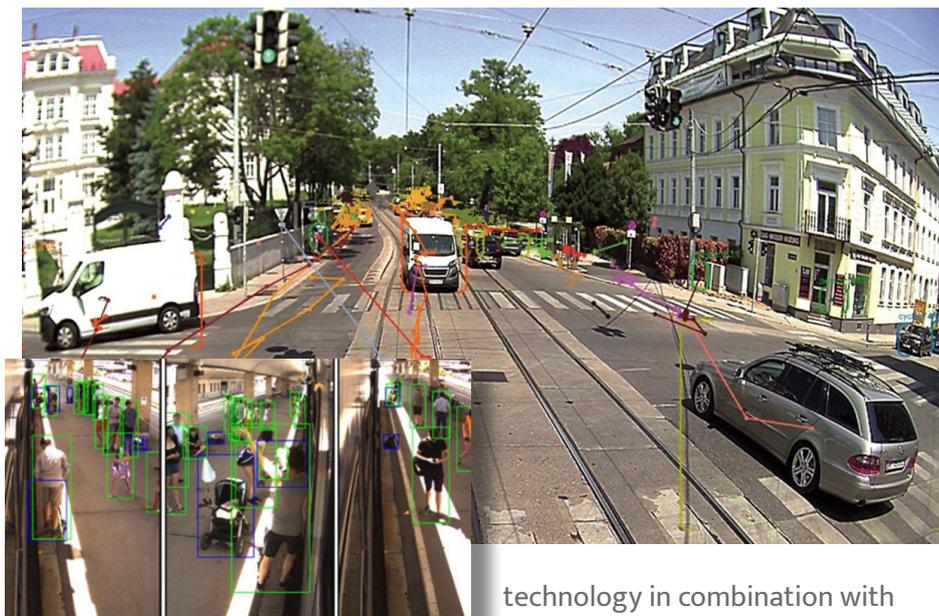
enough time to stop the train or to take other appropriate measures. If automatic brake intervention is implemented, braking is initiated if the driver does not intervene. Due to a minimised error rate of deep learning AI and EYYES' optimised use-case software, drivers are only warned when there is a real risk of collision.

The Front Collision Assistant is currently undergoing extensive testing on trains in Switzerland at Stadler with a Swiss public transport operator. The system will be installed and rolled out in other vehicles before the end of 2022.

As an extension of the driver assistance, the coupling monitoring of EYYES offers the possibility to ensure the safety on the coupling of trains. The installed camera can monitor the coupling connection of trains. If a dangerous situation should arise, a person climbs over the train connection, the driver is warned of visual and acoustic warning signals. Optionally, the image can be displayed on a monitor showing the people in the danger zone.

Another intelligent product is the Blind Spot Assistant, which actively monitors the driver's blind spot in the rear-view mirror of the vehicle. This assistant informs the driver actively in critical situations, recognising people and cyclists in the second row. Thanks to the particularly high-resolution cameras, the Blind Spot Assistant can also deal with difficult lighting conditions and thus provides greater safety for people and vulnerable road users.

The application areas of AI are already being extended to situations around the vehicle. With



active monitoring of the platform, hazardous situations are also automatically detected on the platform. All doors and areas are checked before check-in to prevent potential accidents. Waiting times are reduced, the check-in process is accelerated, passenger safety is increased, and the workload of train crews is greatly reduced.

More than 70 million kilometres driven by rail vehicles equipped with an EYYES rear-view mirror are proof of the robustness of the systems.

The following products and solutions are already available:

- RailEye® 2.0 electronic exterior mirror
- Front Collision Assistant
- Coupling monitoring
- RailEye® 4.0 digital outside mirror with blind spot detection
- RailEye® for Station

EYYES also offers its technology to customers, partners and OEMs for the development of their own driving assistance products and new AI-based use cases. Sensor

technology in combination with an in-house developed and fully trained deep learning algorithm for the detection, recognition, and classification of objects are available. EYYES also integrates the software into the appropriate and desired hardware.

EYYES is therefore the perfect partner for AI solutions in the railway industry.





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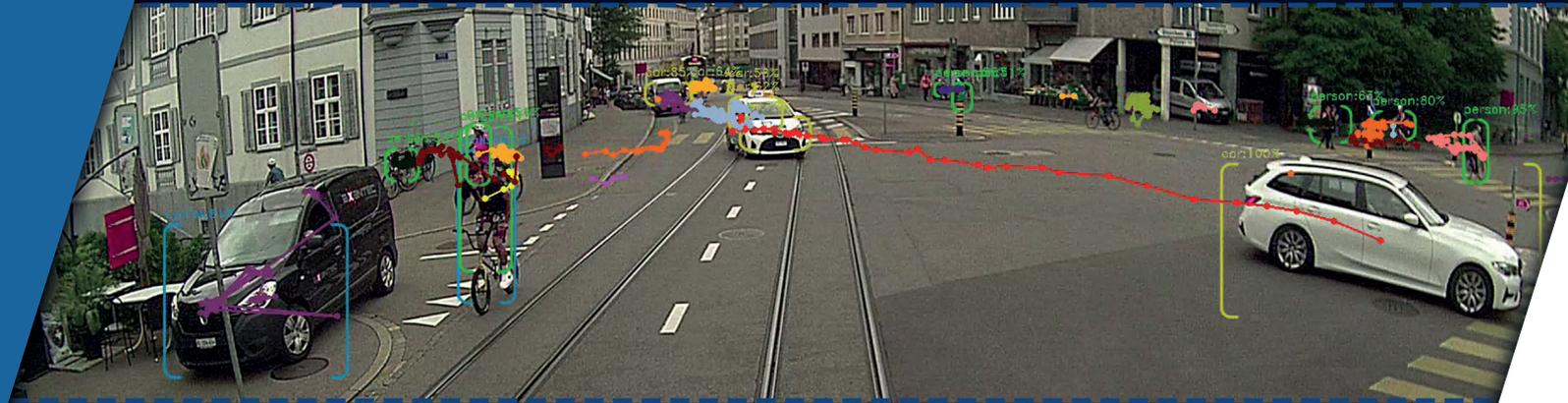


EYES

we make
machines see

RailEye® Solutions

ARTIFICIAL INTELLIGENCE MEETS RAILWAY



OBJECT DETECTION

Artificial Intelligence detects people & calculates the expected direction of movement



WARNING SIGNAL

In case of danger warning signal or brake intervention (optional)



ALL-IN-ONE SOLUTION

Complete Software & Hardware, custom-made for your use-case

GET TO KNOW OUR

RailEye®
Family

Front Collision Assistant
Coupling Monitoring
RailEye® for Station
RailEye® 2.0 - EXTERIOR MIRROR
RailEye® 4.0 - DIGITAL MIRROR



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