Innovating Europe's Railways: How exoskeletons and Augmented Reality are changing the tracks

Keeping trains running smoothly requires incredible effort and physically demanding work. Today, Europe's rail system is exploring cutting-edge technology to assist the dedicated teams that maintain our railway infrastructure. By bridging the gap between human effort and advanced technology, new solutions are being designed to make maintenance safer, smarter and more efficient within the FP3-IAM4RAIL project.

Here is a look at two exciting innovations currently in development to support railway maintenance crews. The first technology are exoskeletons which provide physical support to workers that need to complete strenuous and repetitive tasks in complex ergonomic conditions. The second technology focuses on the cognitive support of the operators by guiding them in an intuitive manner using Augmented Reality.

Supporting workers with hybrid exoskeletons

Railway maintenance operators routinely face physically demanding tasks. To support these workers, researchers at CEIT (Centre for Technical Research and Studies in Gipuzkoa) are building a novel, hybrid upper-body exoskeleton designed specifically for the unique needs of the railway industry.

Here is how this wearable technology is changing the game:

- **Targeted support:** the exoskeleton is specifically designed to assist workers during strenuous, over-the-shoulder operations.
- **Adaptable hybrid technology:** the suit features a hybrid design, functioning as a lightweight passive exoskeleton that can be quickly converted into an active, powered suit using on-demand "snap-in" solutions when extra strength is needed.

The project is supported by the Europe's Rail Joint Undertaking and its members.

- **Prioritising safety:** because railway work requires strict safety protocols, the exoskeleton is built to be fully compatible with complex protective equipment, including fall harnesses.
- **Health and well-being:** the primary goal of this technology is to assist workers performing heavy duty tasks, such as safely moving heavy loads. By withstanding most of the weight, the suit should help significantly reduce physical load, strain and the risk of on-the-job injuries.

Initial tests of the exoskeleton are being conducted at different facilities across Europe, demonstrating the capabilities of the exoskeleton in a realistic operational environment, starting at the San Donato experimental facilities by RFI (Italian Railway Network) in Bolonia (Italy).

Guiding operators with Augmented Reality (AR)

Beyond physical support, maintenance teams are also receiving high-tech visual assistance. New Augmented Reality (AR) tools and technologies are being developed to help guide operators through complex tasks in remote locations.

This technology brings the digital world onto the tracks:

- **Overcoming outdoor challenges:** historically, using high-tech devices in the railway sector has been difficult because work often takes place outdoors in remote areas with poor communication networks.
- **Smart digital blueprints:** to bypass complicated programming, researchers at CEIT are creating specialised tools that easily reuse existing digital blueprints—such as CAD models—to generate visual, step-by-step digital representations of work orders.
- **AI-powered vision:** these AR systems are being equipped with Artificial Intelligence (AI) models that can automatically identify and pinpoint the exact location of specific railway assets in the real world (see Figure 1).

As proof of concept of the technology, an initial experiment assessed the support of operators during the calibration of a laser-based track measuring device. The application (see Figure 2) provides step-by-step information about the task that needs to be completed by the operator. In more advanced scenarios it could also validate that specific steps have been completed successfully using AI, such as in correct cabling.

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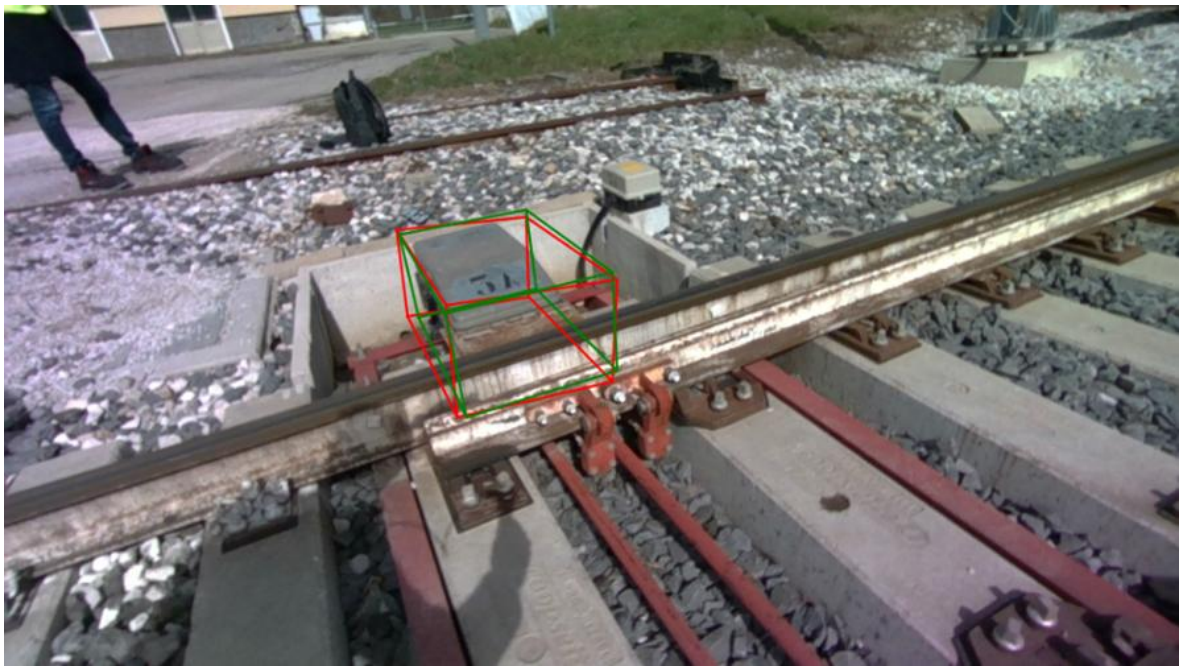

Figure 1. Visual localisation of a Point Machine

Figure 2. AR Instructions of the setup for a track measuring device

By bringing exoskeletons and smart AR glasses out of the laboratory and onto the rail network, the future of railway maintenance is shaping up to be safer and highly innovative!

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