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Title

Extended Reality Safety Nets for Attention Guidance in Airport Control Towers

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Abstract

As a matter of fact, Extended Reality (XR) technology is transforming the way to interact with the surrounding world, and the aviation industry is no exception. In airport control towers, XR can be exploited to overlay all the auxiliary information needed with the real-world data supporting the controllers during their operations without forcing them to continuously scan data on head-down displays and switch between the primary head-up out-of-the-tower visual field and the auxiliary head-down equipment [1], with a benefit in terms of workload and situational awareness [2] and lowering the risk of not detecting unpredictable situations. With the same aim of an improved situational awareness, synthetic Safety Nets can be integrated with the out-of-the-tower view to guide the controller's attention toward alerting situations [3]. For instance, XR tools can be used to display alerts and warnings about potential safety risk, such as aircraft on collision courses or runway incursions helping the air traffic operators to quickly identify and respond to potential hazards, and take corrective actions in case of emergencies.
An operational concept for attention guidance through the usage of Extended Reality Safety Nets based on visual and auditory cues in airport control towers is developed for the simulated scenario of Bologna Airport in Italy.
To assess whether and how the air traffic controllers' Human Performances benefit from the introduction of XR Safety Nets, a human-in-the-loop technical test involving experienced air traffic controllers, is executed on a 30 minutes exercise in the simulated scenario of Bologna Airport. As a proof of concept, a safety event, and more precisely a runway incursion by an unauthorized runway inspection vehicle, triggers the activation of a red tracking label for the aircraft involved in the situation and of a directional acoustic alarm. The directional audio cue is present not only to drive the attention of the controller in the proper direction, but also to compensate for the reduces augmented field-of-view of the specific XR see-through head-mounted-display device used.
To evaluate the impact of the Extended Reality Safety Nets introduction in airport control towers, the solution scenario - including the XR device - is compared with a reference one where the controllers are not supported by the technical solution.
The outcome of the simulation test prove how the proposed solution is effective in reducing both the time needed by the controllers to notice and react to a safety event and the number of switches between the head-up and head-down position. Moreover, the controllers report a positive impact on the potential for human error, a benefit for situational awareness and an enhanced team situational awareness.

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