

Abstract

Extended Reality as enabling technologies for Innovative Air Mobility: a User Centered approach*

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Significant efforts in the aviation sector are currently focused on integrating Innovative Air Mobility (IAM) services into current airspace operations. However, some challenges still need to be addressed in order to effectively integrate these services and systems into urban spaces [1]. Since IAM is still not at fully operational level, safe simulation environments are essential for anticipating and exploring *what if* future IAM operational scenarios. To this end, immersive technologies such as Extended Reality (XR) offer a promising solution by enabling realistic and interactive simulation environments. In this context, this paper proposes an XR-based platform as a safe and sustainable prototyping environment for simulations of IAM operations. Following the User Centered Design approach, the platform provides a modular framework that connects diverse IAM users and stakeholders to different XR-based applications. Each XR application, in turn, is developed based on a deep understanding of its context of use, user and its respective user requirements. The platform, that is presented in Figure 1, is developed centered in the Digital Twin model, the simulation environment that integrates a range IAM-related data layers necessary to replicate diverse operational scenarios. Therefore, these data bases, that are mostly composed of three-dimensional models, must reflect components part of IAM scenarios, including the 3D virtual models of IAM aircraft and their trajectories, the 3D virtual models of the urban area, the 3D models of the Overlays (text strings or geometrical shapes that provide additional information to the user) and the 3D models of vertiports. Four XR applications have been deployed, addressing different IAM users and their respective requirements, exploring distinct XR devices. The first application, deployed to a Tablet, aims to support drone pilots and operators when conducting the Specific Operations Risk Assessment. By exploring different perspectives of the operational scenario, the application provides an enhanced awareness to the operator regarding the

surrounding environment and supports ground and air risk identification as well as understanding the effective feasibility of proposed mitigative solutions to the identified risks. The second application addresses the social acceptance of drone operations in urban environments by means of a Virtual Reality (VR) application deployed to a VR head-mounted display. This XR application provides an immersive urban environment with the additional drone traffic in order to assess pedestrians' perceptions regarding these drone operations. The third application provides a proof-of-concept of drone traffic visualization in Immersive Reconfigurable Interaction System (IRIS) Cave infrastructure. With the aim of providing an immersive simulation environment supportive of training of future drone operators, the system enables the visualization of the strategic phase of flight of urban drone missions. Finally, the fourth application explores the potential of virtual reality technology to support the design, complemented by simulating first person experience of an arrival and departure air taxi flight. This XR application is still at early design stages but initial results indicate high system acceptability. An overview of the described applications will be provided during the presentation.

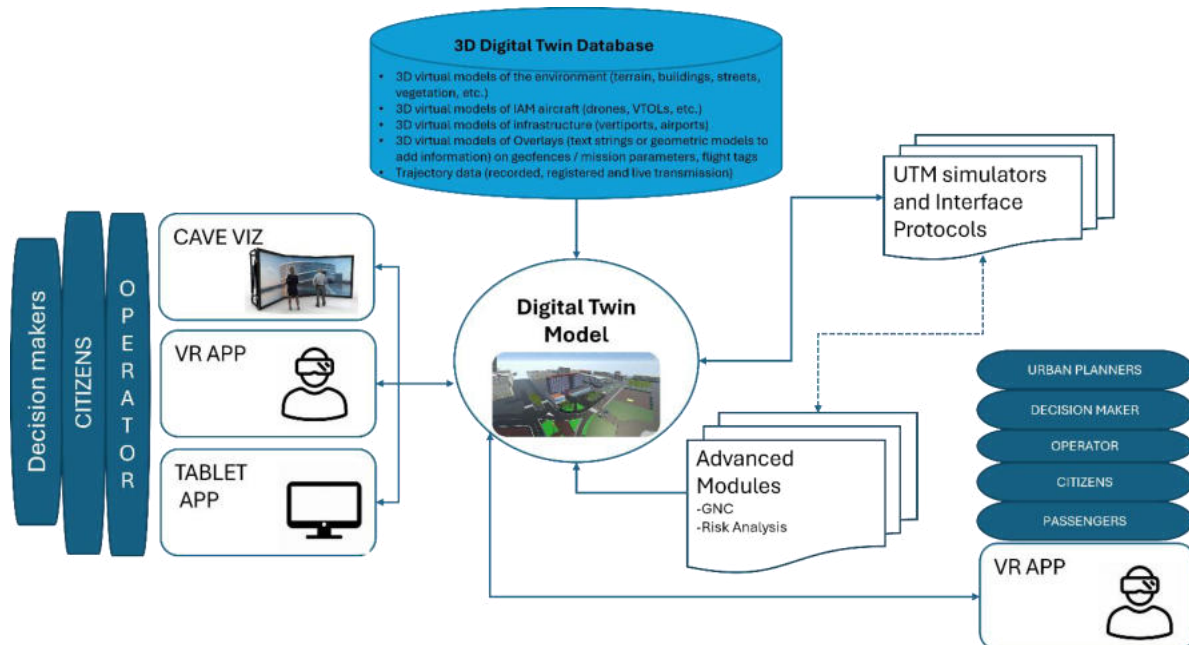


Figure 1 The modular architecture framework provided by the proposed XR-based Simulation Platform to IAM applications.

[1] Innovative Air Mobility for City Transport Ecosystems. European Union Safety Agency (EASA). <https://www.easa.europa.eu/en/domains/drones-air-mobility/drones-air-mobility-landscape/IAM-for-City-Transport-Ecosystems>. Last Accessed 15/07/2026.

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Biography

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Millene Gomes Araujo is a Researcher at the University of Bologna, Italy. Her work centers on applying User Centered Design principles and advanced Human-Machine Interfaces to create immersive applications within the airspace domain. She is currently working on developing XR solutions for Innovative Air Mobility.