

## INTEGRATION OF AUGMENTED REALITY TECHNOLOGIES IN IMMERSIVE THEATRE PRODUCTIONS

Within the framework of digital culture, characterized by interactivity, network architecture, and multimodal data transmission, the classical model of theatrical communication, based on a fixed division between the stage and the auditorium, increasingly demonstrates limited functionality. In this context, the integration of augmented reality (AR) technologies into theatre productions is considered not as an experimental visualisation, but as an instrumental response to the necessity of re-engineering the theatrical environment and the channels of interaction between participants in the performative system [1, 2].

The relevance of this research is driven by the need to implement technically sound means of artistic representation, capable of ensuring a high level of interactivity, spatial accuracy, and synchronisation between the physical and digital components of a performance. In this sense, AR transforms the spectator from a passive information recipient into an active interactive node within the system, simultaneously generating input data and receiving adaptive content. This model alters the architecture of communication between the author, performer, and audience, bringing it closer to cyber-physical systems.

Digital interfaces, particularly AR modules, within a theatrical production are integrated directly into the scenic structure as functional components of the performative environment. They serve the role of dynamic visualisation layers, spatial orientation, and navigation tools, rather than mere decorative effects. This requires precise coordination between stage action, digital scripts, and real-time tracking algorithms [2].

In contrast to virtual reality (VR), which implies the complete isolation of the user within a synthetic environment, AR operates by overlaying digital objects onto the physical space of the stage. This approach allows for the retention of key theatrical characteristics the live presence of the actor, the physical acoustics of the space, and direct contact with the audience – while simultaneously expanding them through programmatically controlled visual and aural elements.

A critically important factor in the realisation of AR theatre is the architecture of the technological system, which must ensure stable operation under multi-user scenarios. Key technical parameters include tracking accuracy, minimal rendering latency, network bandwidth, and system synchronisation reliability. Even a minor latency between an actor's action, the processing of sensor data, and the visualisation of AR

content can lead to user disorientation and the breakdown of the sense of presence.

AR scenography is regarded as a software-controlled system of spatial transformations, within which physical sets are augmented by dynamic digital structures. Using AR, it is possible to realise the morphing of scenic objects, procedural environment animation, and the simulation of alternative spaces and scales. In this case, the stage space functions as an interactive interface, responding to input signals from tracking systems, motion sensors, and audience behavioural algorithms.

The integration of AR also significantly alters acting techniques. The actor interacts not only with physical partners and props but also with virtual objects that exist within a shared coordinate space yet are displayed only through digital interfaces. This demands precise spatial timing, preliminary calibration of stage zones, and work with digital markers [3].

Alongside technical advantages, AR integration generates a number of risks associated with the processing of personal data, behavioural tracking, and user cognitive load. A distinct technical direction involves the use of AR to enhance theatre accessibility, specifically through the implementation of adaptive subtitles, spatial audio description, and the visualisation of sonic events. This requires additional data processing modules but significantly expands the potential audience for theatrical productions.

Effective integration of AR into theatre is only possible under a systemic approach that combines engineering precision, considered interaction design, and a responsible artistic concept.

### References

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