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## **Складнощі в дизайні систем доповненої реальності**

**Анотація:** Розглянуті технологічні обмеження, які мають вплив на дизайн AR та потребують вирішення. Зокрема, дизайн для проєкційної доповненої реальності має враховувати такі чинники, як доступна роздільна здатність, колірний динамічний діапазон, колір та текстура поверхні для проєкції, рівень чорного, фокусна відстань та навколишнє освітлення. Попередня обізнаність, внесення змін та тестування на місці є запорукою отримання бажаних результатів та позитивного досвіду від AR.

*Ключові слова:* SAR, проєкційний дизайн, доповнений дизайн, просторова проєкція.

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## **Challenges in the design of augmented reality systems**

*Key words:* SAR, projection design, augmented design, spatial projection.

Augmented reality technologies have their bottlenecks that must be taken into account when designing augmented reality systems. A key advantage of spatial augmented reality (SAR) is that the user does not need to wear a head-mounted display and has a large field of view. It is also possible to generate a greater volume of integrations of virtual objects with real ones and, if necessary, to improve the sense of immersion. The main challenges in creating a projector-based spatial augmented reality (SAR) are its limited resolution, low dynamic range, color and texture surface requirements, high level of black color and short focal length.

The projection surface should be light in color and has smooth geometry. It is practically impossible to reproduce bright images on highly reflective, low-reflective or dark surfaces, so it has to be matte and smooth in texture. Regardless of the fact that there are technologies for compensating for unevenly painted backgrounds, a projector resolution that is too low results in too large pixel projections that cannot accurately cover the fine pigments on the screen surface and compensate for the background color. In the large projections, the contrast and sharp borders can become blurry and as result to be not precisely matched with hard object faces.

The level of the black color is highly dependent on the ambient lighting. Even in a completely dark room, the black color from the projector makes the surface of the screen visible all the time. Thanks to local contrast, this can be compensated: dark areas surrounded by brighter ones seem much darker than they really are. Too bright ambient light reduces the contrast of images and makes it difficult to display dark colors. Too light colors could be barely visible in illuminated environments too, so the values lower than 10 % of pigment have to be used carefully and tested.

**Section 4.** Problems of modern art and art management

The limited depth of focus of conventional projectors prevents them from displaying images on screen surfaces that are extremely curved. This problem is solved either by using laser projectors or by using several projectors at the same time. Beams from a frontal projector can be partially blocked by the bodies of the audience and cast shadows on the projections; here again many projectors come in handy.

Projection testing in working conditions makes it possible to compensate for possible display issues in the design and obtain the expected result.

