Improvements on Dihedral Corner Reflector Array Towards Wearable Retinal Projection Augmented Reality Device

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In this study, we focused on making retinal projection augmented reality (AR) devices wearable by using a dihedral corner reflector array (DCRA). We developed and tested a crossed half-silvered mirror array (ChMA), where we replaced the DCRA material with one with higher transparency. Although AR technology has attracted considerable attention recently, an ideal AR device that overcomes the optical challenges has yet to emerge. One promising solution is to use DCRAs with a metamaterial structure of many tiny mirrors for retinal projection, offering wider viewing angles and higher resolution than other methods. However, a major problem with DCRAs in retinal projection is their low transparency, which results in a clear image but a significantly darkened view of the outside world. This study proposes the ChMA, which retains the DCRA structure but with more transparent mirrors, to improve external visibility while retaining retinal projection functionality. For validation, ChMAs with different mirror thicknesses and materials were fabricated and compared with commercial DCRAs in terms of transparency and retinal projection capabilities. The results showed that our fabricated ChMAs significantly outperformed commercial DCRAs in terms of transparency, and while there is room for improvement in projected image quality, they also maintained retinal projection functionality.

The work presented in this thesis was published in 2023 ACM SIGGRAPH Posters as "Crossed half-silvered Mirror Array: Fabrication and Evaluation of a See-Through Capable DIY Crossed Mirror Array" [13] and texts and figures were reproduced from [13] with the permission of ACM SIGGRAPH Publishing. The author led the whole fabrication process of the ChMAs, executed experiments, analyzed and discussed the results from the experimental results.

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