Article: Metasurface wavefront control for high-performance user-natural augmented reality waveguide glasses
Journal: Nature
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This article investigates how waveguide glasses works for augmented reality. They built a model of waveguide glasses consists a laser projector as a light resource, a piece of RGB glass (instead of many pieces of single colored glasses) to transit the light, and a lens and a white screen to receive light as human eyes. They calculated the best angle to guide the wave reflection through the glass. Their work successfully project laser images on an eye-equivalent screen, but it only works especially good on red light. They have a plan to fix it by changing the ratio of red, green, and blue light.

This research article clearly defines the issue the researchers are investigating – The first issue is how the waveguide works. They allow the light reflect in the glass over and over again, then the light comes out at the end of the waveguide glass. But I believe one or two reflection is enough to guide the light to eye. I will test it out later in my research time. The second issue, which is less related to my research, is the material of the glass. I think thin, normal glass is enough for my project. It is not necessary for me to do extra work on the material, only the shape is a fateful issue for me.

This article relates to my research because I want to build a model of projector on glasses. It is also a form of augmented reality. My original thought was just one reflection to eyes, which comes from the image on my glasses when I face back to the windows. Researchers provides my another way for me to try – light goes through the glasses, and it reflects massive times. Also, their image trial which red and green light is separated reminds me the wavelength of light will affect the angle of reflection. So I think I should work on single color first, and remains my idea of single reflection.

The methods and procedures of this experiment are explicitly detailed. First, the researchers drew the concept view of their model, it showed how light were supposed to go through the ray tracing glass. Then they used a method called device fabrication to build the glass with many kinds of semiconductor like Si_3N_4, and gas mixture like SiH_2Cl_2 and NH_3. After this, the researchers compared different designs of prototypes of the glasses with all kinds of parameters, for example, display type and display resolution for light output, thickness and number of waveguide glasses, and eyebox size and focal plane for the receiving part. At last, they tried to put an image on to the waveguide glass. It appeared that red, green and blue colors were separated due to their different wavelength, but is worked good for low efficiency single color images. My idea seems to display low efficiency single color images, but only one reflection may works better than multiple reflections, I will figure it our in my development phase. The researchers would be going to do more research on multiple colors and high efficiency images.

The results of the study were clearly presented and explained thoroughly. The researchers used plenty of graphs, forms and photos to show the test data before they build the model and the outcome of their waveguide with different color light. For the light, their glass works the best with red light. I think I can start with red light.

This article explores the best materials of waveguide glass and the best angle of reflection and refraction when the light goes through the glass. Currently, I think the materials are not important for me, the most helpful point is the angle. If I want to improve my glasses into a colorful one, I need to add more complicated structures. The other problem for me is to scale down the model. I think my model does not need much reflection, so a piece of thin plain glass might be enough for me. But the most important issue is the tiny projector, it will cost a lot for such a small and precise machine. I believe there can be some replacement. For example, I am thinking to use a transparent paper with just black marks, and use a flashlight to produce the light. The switch of pages can be like the wheel of Revolver. All these issues are for late development, now I should mainly focus on decide the reflection angle of my glass. It will take a lot of math work.

This study did yield information about a similar method of decontamination – the researchers successfully built a model of waveguide glasses. It does project an image aside from the eye model on the eye. But the project took a lot effort on materials, which seems not important for me currently. This study shows a progress on augmented reality, it provides one theory for one of the most important equipment of the region. It allows users to see the image on glasses. The researchers also acknowledge their limitation, their glass can only show single color perfectly, which means it is not good for colorful image now.

From the study, I think I can think of their problem found after building the model, and I can also reference their materials and design to improve my glass, but I will still insist on my original design. But I think I should work on one color at the beginning, because it is so complicated to calculate the light wave with different wave length and build the equipment. If others will read this article, I advice them to mainly focus on what problem the researchers found. We need to understand their difficulty and try to avoid them on our own project.

References

1. Hyunpil Boo, Yoo Seung Lee, Hangbo Yang, Brian Matthews, Tom G. Lee & Chee WeiWong. (2022). Metasurface wavefront control for high-performance user-natural augmented reality waveguide glasses. Nature, 12:5832. https://doi.org/10.1038/s41598-022-09680-1