HIGH-PERFORMANCE HOLOGRAPHIC OPTICAL ELEMENTS FOR AUGMENTED-REALITY SMART GLASSES

DATOS DE CONTACTO:

Research Results Transfer Office-OTRI
University of Alicante
Tel.: +34 96 590 99 59
Email: areaempresas@ua.es
http://innoua.ua.es

RESUMEN

The *Holography and Optical Processing* research group (*GHPO*) of the University of Alicante has developed high-performance holographic optical elements for augmented-reality smart glasses, capable of directing the image from a micro-projector towards the user's eye while keeping the lens transparent to the surrounding view.

By means of proprietary design software (HoloTraceX), the technology compensates from the design stage for the main sources of distortion — material shrinkage, wavelength mismatch and lens curvature — and integrates each user's optical prescription into the hologram itself. This makes it possible to obtain sharp, low-power images on curved, personalised lenses, and it is compatible with both holographic-mirror and waveguide architectures.

The technology, protected by two patent applications and software registered by the University of Alicante, has been developed at laboratory scale. Companies interested in its development and commercial exploitation are being sought.

VENTAJAS Y ASPECTOS INNOVADORES

ADVANTAGES OF THE TECHNOLOGY

The technology offers the following distinctive advantages over current solutions:

- **High optical efficiency**: it optimises the hologram's diffraction performance, making the most of the micro-projector's light to achieve a brighter image.
- **A sharp, stable image**: it corrects, from the design stage itself, the geometric and chromatic distortions caused by wavelength mismatch, material shrinkage and lens curvature.
- **Integrated prescription**: it incorporates the user's visual correction (myopia, astigmatism or hyperopia) into the lens itself, with no need for additional corrective lenses.
- **Lightweight, discreet design**: it is integrated onto curved lenses of conventional appearance, making discreet AR glasses viable instead of bulky devices.
- **Integration versatility**: valid both for holographic-mirror and waveguide glasses, the two main approaches on the market.
- **Low power consumption**: the high optical efficiency reduces the power the micro-projector requires and extends battery life.
- **Proprietary design software (HoloTraceX)**: owned by the University of Alicante, it optimises each hologram by jointly resolving shrinkage, wavelength mismatch and curvature.
- **Simple, transparent integration**: the holograms are laminated directly onto the lens thanks to the self-adhesive photopolymer and become completely transparent after bleaching.
- **Access to a much larger market**: the integrated prescription opens AR to the huge population of people with optical prescriptions,

currently poorly served by conventional AR glasses.

- **Lower development cost and time**: by compensating for distortions from the design stage, iterations and physical prototypes are reduced, accelerating industrialisation.
- **Lower energy footprint in use**: the low power consumption reduces the energy the device demands and may allow smaller batteries, using fewer materials.
- **Visual inclusion and accessibility**: it allows people with refractive errors to use AR glasses without uncomfortable adapters or double glasses, adding an inclusive dimension to the technology.
- **Greater visual comfort**: a better-corrected image, with fewer aberrations, could reduce visual fatigue during prolonged use.

INNOVATIVE ASPECTS OF THE TECHNOLOGY

The main innovative aspects of this technology are the **joint compensation of all sources of distortion from the design stage itself** and the **encoding of the user's optical prescription within the hologram on curved lenses**. Both constitute the technical foundation that makes the advantages described possible and that, to date, had not been addressed comprehensively in the prior art.

The first lies in the computational design method (HoloTraceX software). Instead of correcting each defect separately or through post-manufacture adjustments — as known solutions do — the system computes in a single step the exact microstructure that simultaneously counteracts the three physical effects that degrade the hologram under real conditions of use: material shrinkage, the difference between the recording and reconstruction wavelengths, and the deformation introduced by lens curvature. This unified, anticipatory treatment of factors traditionally considered in isolation is what is technically novel compared with existing partial pre-compensation methods.

The second consists of incorporating the user's individual optical prescription (myopia, astigmatism or hyperopia) directly into the hologram microstructure, recorded on a curved substrate. In this way, a single optical element performs at once two functions that until now required separate solutions: combining the virtual augmented-reality image and correcting the user's vision. It is precisely this joint adaptation of curvature and prescription within the hologram itself that previous techniques did not resolve, focused as they were on flat surfaces and without refractive personalisation.

APLICACIONES DE LA OFERTA

The technology is aimed at manufacturing holographic optical elements for augmented-reality smart glasses, with direct application in:

- **Consumer electronics**: AR smart glasses for everyday use.
- **Ophthalmic optics and eyewear**: AR glasses with the user's prescription integrated into the lens itself.
- **Industrial and professional augmented reality**: hands-free superimposed information in manufacturing, logistics or maintenance.

Additional potential uses:

- **Healthcare and clinical AR**: superimposed visualisation as support in surgery or medical assistance.
- **Automotive and transport**: transparent holographic combiners of the head-up display (HUD) type.
- **Defence and aeronautics**: visors and helmets with integrated visualisation (head-mounted displays).
- **Sport**: athletes can view biomedical data on their glasses — heart rate, power output (watts), etc.

COLABORACIÓN BUSCADA

The University of Alicante is seeking companies interested in incorporating this technology into their products and exploiting it commercially. Avenues of collaboration include:

- Licence agreements for the patent and the HoloTraceX software for its industrial development and commercialisation.
- R&D collaboration for the adaptation and development of the technology through to prototype validation and its integration into a product.
- Scientific and technical advice from the research team.

In particular, collaborations will be welcomed with:

- Manufacturers of smart glasses and augmented-reality devices.
- Companies in the ophthalmic-optics and eyewear sector.
- Manufacturers of optical components and holographic elements.
- Integrators of augmented-reality solutions for industrial and professional environments.