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Automatic Lens Placement for
Personalized 3D Printed Eyewear

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Problem

People differ in eye spacing, nose shape and head width, so a standard eyeglass frame may not position the lenses appropriately while also fitting the face comfortably.

Customizing the fit requires coordinating lens positions, nose-pad contact and frame geometry, often through repeated manual measurements and adjustments. The challenge is to determine lens placement from individual facial geometry and adapt the frame while preserving that placement.

Three coupled design constraints

Lenses: align their centers with the eyes.
Nose pads: establish appropriate support.
Frame: adapt rims, bridge and temples to the face.

Related work & motivation

Smartphone-based eyewear fabrication [1]
Previous work combines smartphone-based 3D facial imaging with designer-led modeling to produce custom 3D-printed eyeglass frames.

Parametric eyewear design [2]
Measurements from 3D head and face scans are used to drive a parametric model for personalized eyewear frames.

Our focus
We combine facial reconstruction with automatic landmark-guided lens placement, then keep the lenses fixed during manual frame refinement.

Next: validate alignment and long-term comfort across more users, address scan noise, and automate frame refinement.

Our contribution

Automatic lens placement
Derive eye references from multiple views and position lenses automatically.

Geometric assessment
Refine the frame manually and report mesh overlaps and surface distances.

References

[1] de Alba Campomanes et al. 2022. JAMA Ophthalmology 140(10), 966–973. doi:10.1001/jamaophthalmol.2022.3312

[2] Tian and Ball. 2023. Parametric Design for Custom-Fit Eyewear Frames. Heliyon 9(9), e19946.

[3] Lugaresi et al. 2019. MediaPipe: A Framework for Building Perception Pipelines. arXiv:1906.08172.

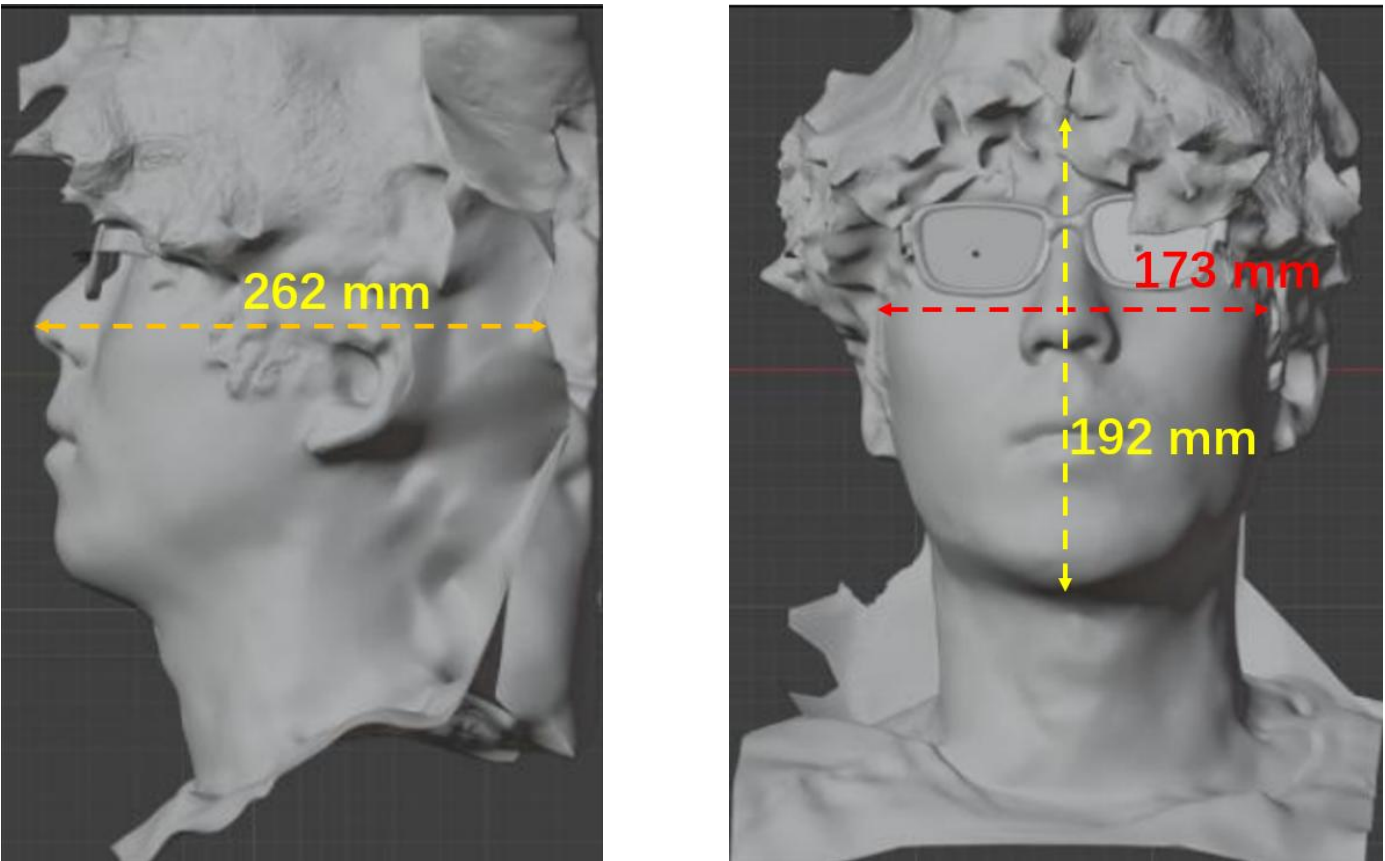
[4] Ruan et al. 2023. Optics Express 31(21), 33799–33814. doi:10.1364/OE.498011.
Full paper: doi.org/10.1145/3828643.3858257
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Method: from face scan to eyewear

Smartphone capture → 3D reconstruction → landmark-based lens placement → manual frame refinement → fabrication

01 Capture and scale

Capture 23 smartphone images per user, from left to right. Reconstruct a textured face in KIRI Engine, then scale it in Blender using ruler measurements.



Example dimensions used to scale the mesh

02 Locate eye references

Render five orthographic yaw views (−25°, −15°, 0°, 15°, 25°). Raycast MediaPipe landmarks [3] onto the mesh; take the coordinate-wise median of valid intersections.



Surface-based references; not direct measurements of anatomical eye centers.

03 Position lenses and pads

Compute interpupillary distance (IPD) between eye references. Align each lens’s bounding-box center and set a 16 mm forward offset [4]. Move nose pads inward incrementally; back off and raise them when cheek contact occurs.

04 Refine and assess

Keep lenses fixed while manually reshaping the frame with mesh tools and a lattice. BVH (bounding volume hierarchy) checks report overlaps and approximate minimum surface distances; they flag issues without moving components.

Results: three personalized prototypes

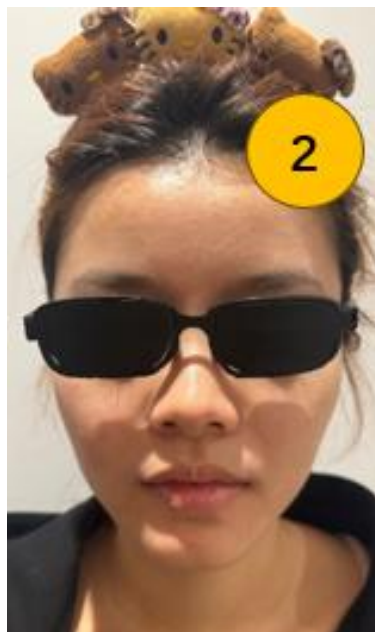
All three users reported a comfortable fit in a brief wear demonstration. Both lenses reached the 16 mm target geometric eye relief in all three models.

Participant 1



Stable fit; no temple pressure

Participant 2



No slippage; suitable lens size

Participant 3



Felt similar to usual glasses

Image-derived IPD	Participant 1	Participant 2	Participant 3
Distance (mm)	69.58	69.41	64.89

Example geometric checks · Participant 1

Nose-pad overlaps: 0 / 0 (left / right); approximate gaps: 0.055 / 0.206 mm.
Lens overlaps: 0 / 190 triangle pairs; suspected hair / scan artifacts remain warnings.

Brief, three-user demonstration; no controlled comparison or long-term validation.