Eye tracking for collaborative music experiences

A framework for recording and analysing collective attention in naturalistic concert settings

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Introduction

- Eye movements are used to study human behaviour and develop interaction tools.
- Eye-tracking in music cognition is, however, limited due to its infeasibility in multi-person naturalistic setups.

Challenges

- Synchronized data collection from multiple people in shared physical spaces.
- Joint analysis of egocentric gaze data from differing viewing perspectives.

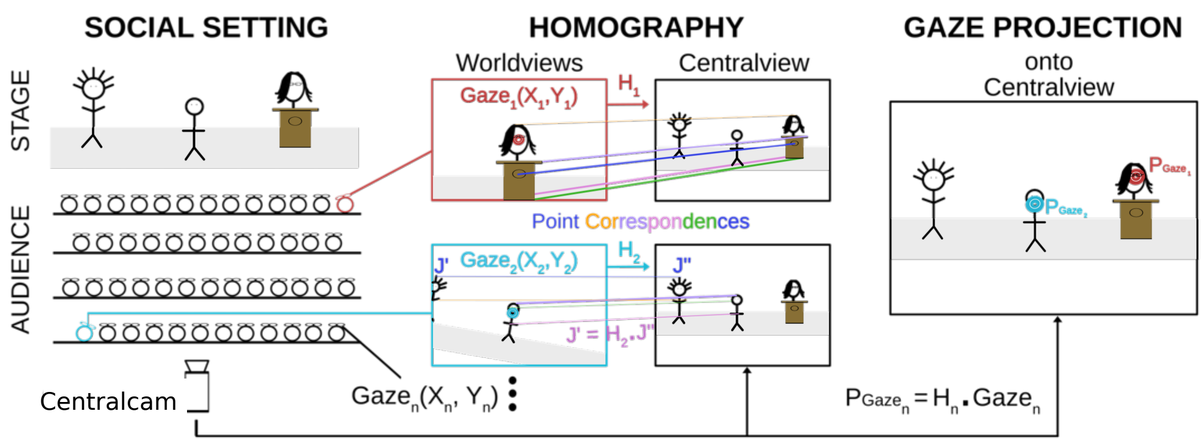

Figure 1. Schematic of a multi-person eye-tracking setup with audience members wearing eye-tracking glasses while gazing at a stage (LEFT). A recording of the stage is also made from a stationary CentralCam, mounted at the back of the audience. Egocentric Worldviews from the glasses are projected onto the Centralview using point correspondences (MIDDLE). The computed relationship between the two views is used to map gaze coordinates of all individuals onto the shared Centralview.

SocialEyes[1]

- Framework to record, synchronise, and analyse multi-person eye-tracking data.
- Projects egocentric gaze of viewers to a common CentralView perspective.
- Enables remote control and real-time monitoring of devices over a local network.
- Provides innovative metrics and visualisations for analyzing joint gaze dynamics.

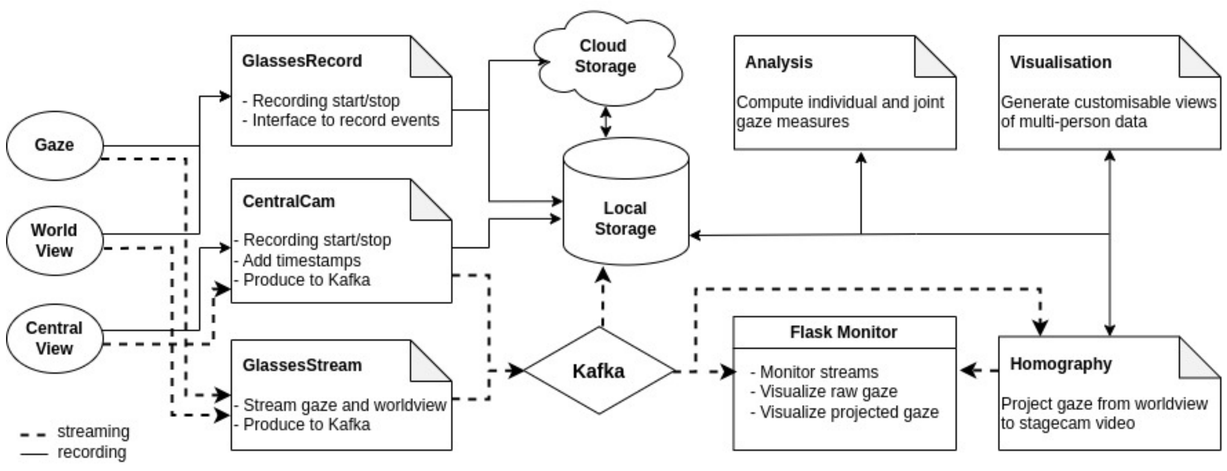

Figure 2. SocialEyes software framework illustrating data flow (arrows) through the system. Solid and dashed lines show recording and streaming modes, with each mode activating separate modules (dog-eared rectangles) for data processing.

Validation Test

- The Innocents: live percussion concert and film screening event at the LIVELab.
- 30 audience members x 2 event days; N = 60.
- Pupil Labs Neon eye-tracking glasses[2] used to record egocentric gaze and worldviews.

Figure 3. Stage and audience setup. Eye trackers were stationed at each seat.

Results & Discussions

- Our time synchronisation protocol reduced clock offsets between devices. Offset drift over the event duration (~3.25 hours) was minimal (M = 9.62 ms, SD = 6.36 ms).
- Gaze was reliably projected onto the CentralView allowing joint analysis.
- Gaze and blink measure timeseries are highly similar across the two repetitions.
- Projected gaze allows joint gaze analyses through novel measures like Contour Area, Blink Probability, and Inter-Subject Correlation.

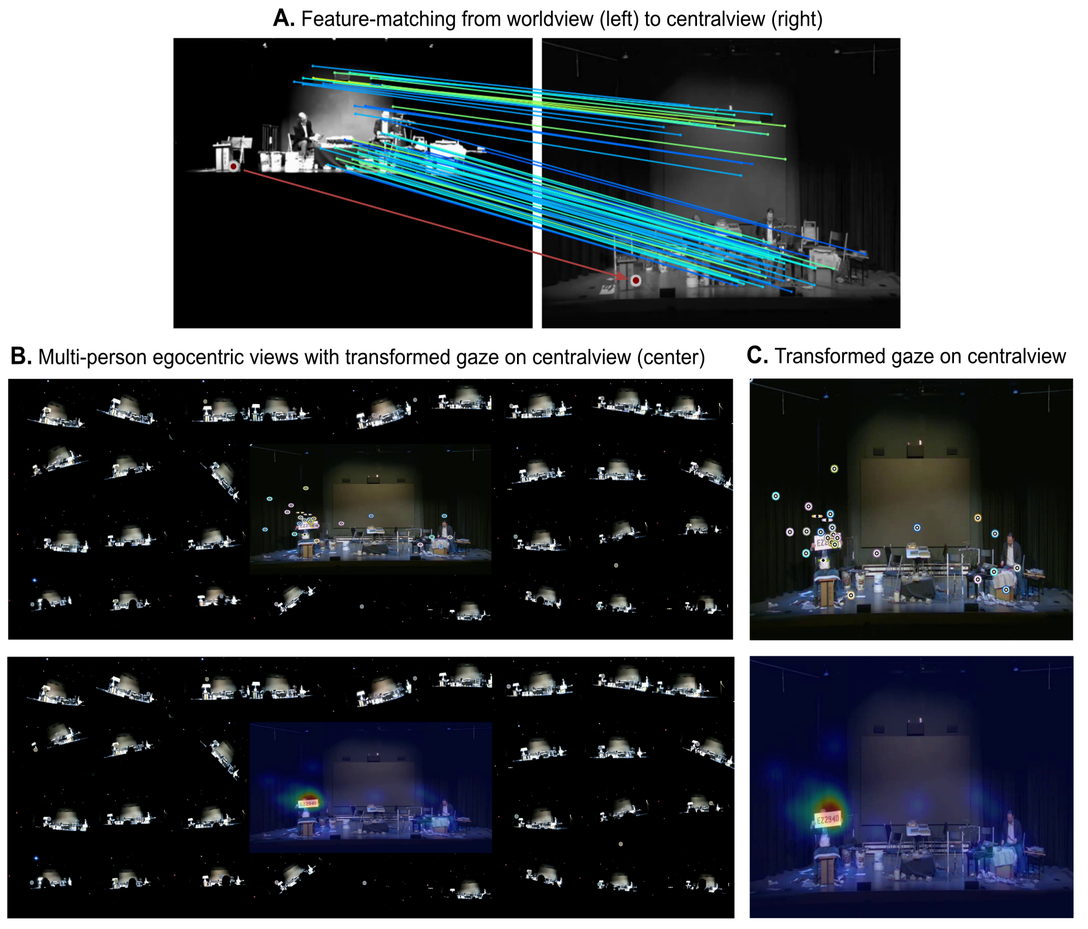

Figure 4. Data processing and visualisation outputs from SocialEyes[1]

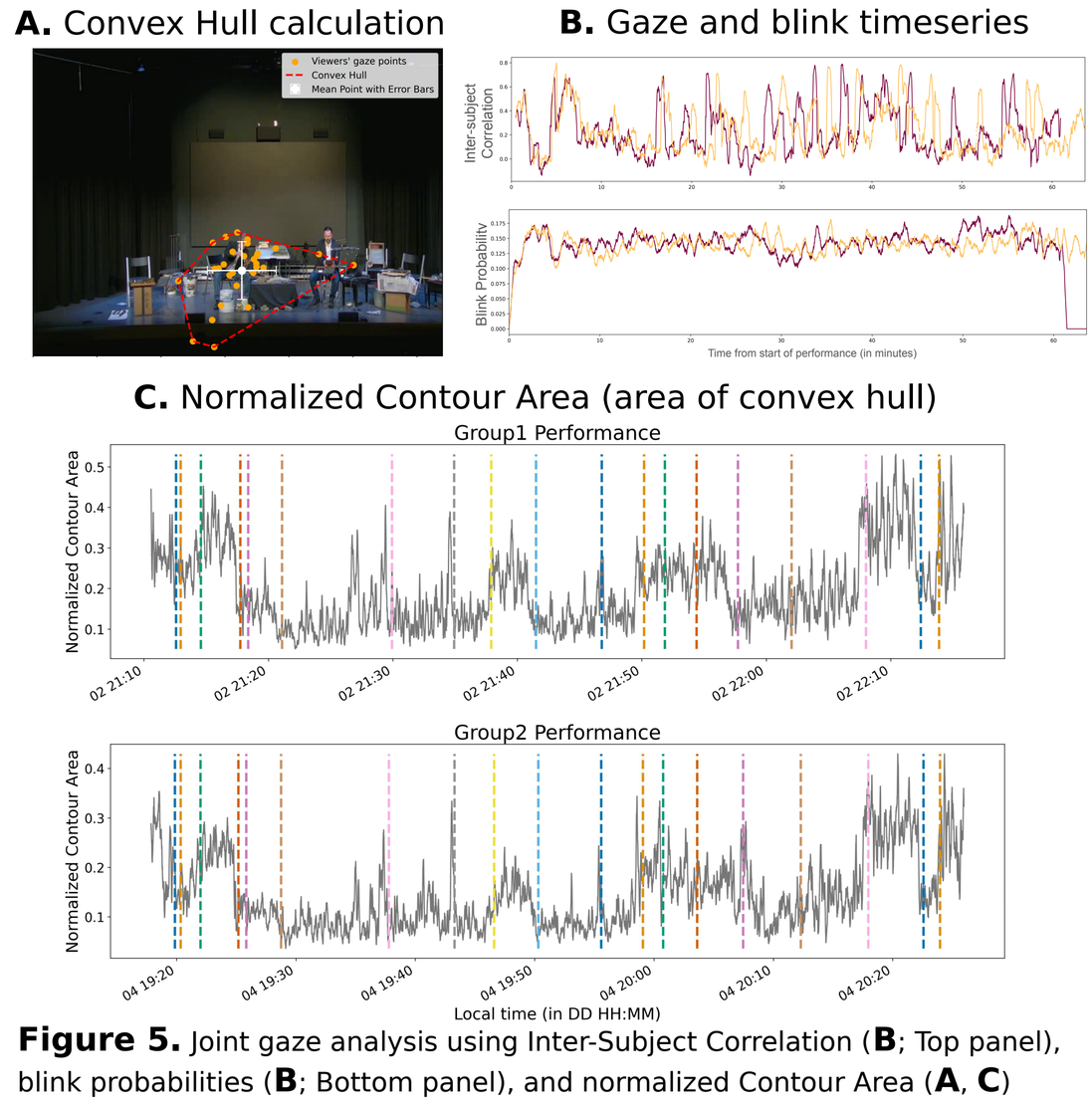

Figure 5. Joint gaze analysis using Inter-Subject Correlation (**B**; Top panel), blink probabilities (**B**; Bottom panel), and normalized Contour Area (**A**, **C**)

Next Steps

- Develop and test the streaming (real-time) mode of SocialEyes.
- Compare gaze, blinks, and pupil data across the two mediums (film and performance).
- Analyse how auditory vs. visual content explains the variance in eye-tracking data.

References

1. Saxena, S., Visram, A., Lobo, N., Mirza, Z., Khan, M. R., Pirabaharan, B., Nguyen, A., & Fink, L. K. (2024). Multi-person eye tracking for real-world scene perception in social settings. arXiv preprint arXiv:2407.06345.
2. Chris Baumann and Kai Dierkes. 2023. Neon Accuracy Test Report. Pupil Labs (2023).

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