A Collaborative Gaze Aware Information Display

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Abstract
In this demo we present a gaze aware display that dynamically adapts its content to two users' interests and attention simultaneously. Prior gaze-interactive systems can only support a single user and require tedious isolated calibration procedures for each usage. We developed a system that allows multiple people to walk up to a large gaze-interactive display that can sense their interests and current focus of attention. For demonstration, we built a tourist map application that first implicitly calibrates users, and then reveals additional information when users look at destinations of interests.

Author Keywords
Eye tracking, Gaze awareness, Public interactive display, Multi-user

ACM Classification Keywords
H.5.2 [Information interfaces and presentation (e.g., HCI)]: Miscellaneous.

Introduction
It is challenging to enable gaze interaction in real world applications due to a tedious calibration procedure and restrictions to single user. Recent work proposed the use of gaze for ad hoc interaction in public environments without explicit calibration procedure and human

assistance [1, 2], however they are limited to a single user. Many displays we encountered in daily life are shared by more than one people. Hence, it is desirable to accommodate multiple users for interaction.

We implemented a novel gaze interactive display that supports two people to walk up to use it. Figure **??** illustrates an example of our application. When users browse the hotel information on the display, they are implicitly calibrated by following the tourist bus moving on the map (a). Afterwards, the map displays secondary information on destinations based on users' gaze patterns without any explicit input (b). A second user can spontaneously walk up and perform calibration (c) and interaction (d) the same way without interrupting the interaction flow of the previous user. The advantage of our system is that it allows users to interact remotely using their natural gaze behaviour without additional devices. Besides the tourist map application, we envision our system can be applied in many scenarios, for example, in smart home and class room.

Prototype

Our demo supports two users simultaneously browsing hotel information on a city tourist map.

Hardware
We use a 55-inch display (120cm $\times$ 70cm), with the bottom bezel positioned at a height of 115cm above ground. Each user stands or sits side by side and at a distance of 2m in front of the display. Two Tobii eyex eye trackers are placed at a distance of 140cm in front of the display, each tracking one user's eyes.

Software
The eye tracking data is forwarded to a server application that is written in c#. This application computes gaze data for each user, and then visualises it to the main display window. We smooth the received gaze data by using a moving average window for 300 ms in order to avoid jittery gaze data (coming e.g. from imprecise tracking and natural eye jitter). The gaze data is then visualised as cursors on the screen. The cursor is a subtle gradient based visualisation with the goal to decrease any annoying gaze visuals when users are looking on the screen.

On the UI displayed is also a set of hotels, including information about name, rating, stars, and price. Their labels also react to the user's gaze information. They quickly appear when a user's gaze is close, and slowly disappear when users do not look at them. We adjust the opacity of the label objects to realise this operation.

Calibration for Two Users
We extended the pursuit calibration method [1] to multiple users. The idea is to integrate a moving object in the map interface with which users get calibrated. In this demo, we use the trajectory of the touring bus moving continuously along a round trip (Fig. **??**). Users are automatically calibrated when they follow the moving bus symbol. Users' gaze pursuit of the bus as well as collection of calibration samples is indicated by a highlighted bus. When 100 calibration samples were collected for a user, the system computes the calibration mapping, and enables gaze based interaction. As each eye tracker can track one user at a time, the gaze stream data are correlated with the same stimulus, while the users identity were distinguished by the device ID.

User Interaction
When users walk up to the display, their gaze are automatically calibrated using the procedure described above. In addition, users' gaze tracking also get

automatically updated whenever they are detected to follow the moving object on the map. When users browse hotel options at different destinations on the map, the gaze patterns indicate their current interest levels. The longer the user looks at it (the system identified a fixation occurred), the system will present additional information (e.g., rating, price and promotions) next to the hotel name.

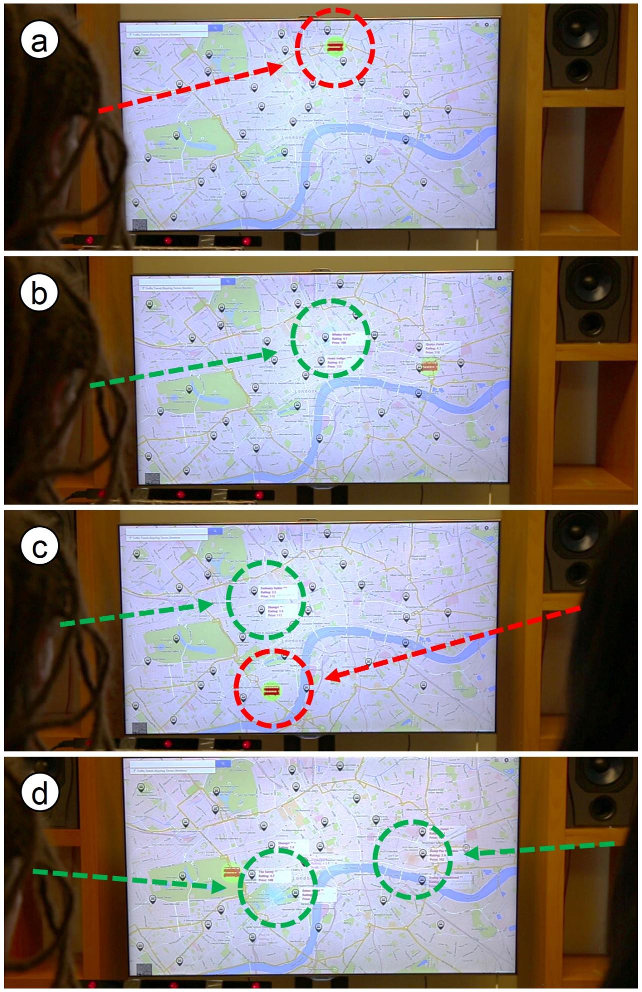

Figure 1: Two-user gaze calibration and interaction: after the first user calibrates by following the moving bus (a), the map displays hotel information adapted toward his gaze (b). A second user can walk up and calibrate at any time (c), to then interact with the gaze-aware display (d).

References

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