
The Anonymous Audience Analyzer – Visualizing Audience Behavior in Public Space

Jiamin Shi

Media Informatics Group
University of Munich(LMU)
Munich, 80333, Germany
jiamin.shi@ifi.lmu.de

Florian Alt

Media Informatics Group
University of Munich(LMU)
Munich, 80333, Germany
florian.alt@ifi.lmu.de

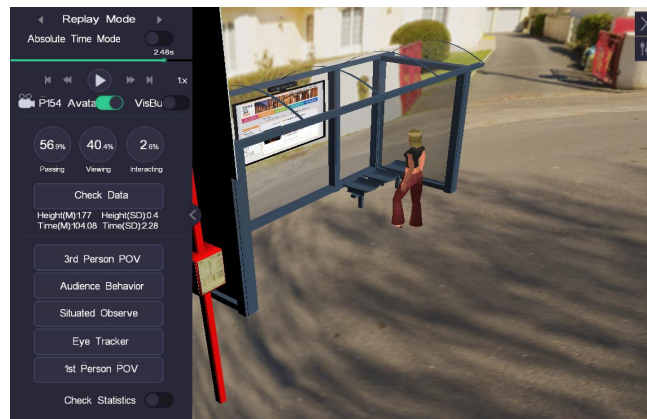


Figure 1: Our audience analysis tool allows interaction data obtained in the real world to be replayed and analyzed in a virtual environment. Thus, the privacy of users is preserved while at the same time providing a rich tool to investigate audience behavior.

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Abstract

With dropping hardware prices, an increasing number of interactive displays is being deployed in public space. To investigate and understand the impact of novel interaction techniques, content, and display properties, researchers and practitioners alike rely on observations of the audience. While in-situ observations are costly in terms of time and effort, video data allows situations in front of the display to be analyzed post-hoc. In many situations, however, video recordings are not possible since the privacy of users needs to be protected. To address this challenge, we present a tool that allows scenes in front of a display to be reconstructed from Kinect data (user position and body posture) and visualized in a virtual environment. In this way, the privacy of the audience can be preserved while allowing display owners to run in-depth investigations of their display installations.

Author Keywords

public displays; audience behaviour; virtual reality

ACM Classification Keywords

H.5.1 [Information interfaces and presentation (e.g., HCI)]:
Multimedia Information Systems—Artificial, augmented,
and virtual realities

Introduction

Past years witnessed a lot of research being conducted on audience behavior in front of large, public screens. In particular, researchers were interested in the effect of display shape [1, 6], interactivity cues [5], and the influence of other persons in the display vicinity [3, 4]. Many of the insights obtained by researchers are a result of in-situ observations (i.e., researchers spending a significant amount of time in the vicinity of a display and carefully observing how people behave) [2, 6]. Further approaches include recording (depth) video data and reviewing it post-hoc [5]. Finally, researchers also used computer-vision approaches to visualize the trajectories of people in front of displays [7].

All of the aforementioned approaches suffer from drawbacks. In-situ observations require researchers to spend a significant amount of time in the display vicinity, where they often need to wait for the next person to interact. Furthermore, scenes cannot be observed but once, meaning that observers need to be highly focused. Video data, in contrast, allows scenes to be watched over and over. However, scenes where interactions occur need to be identified first (an approach as to how this could be done in an automated way was presented in [5]) and video recordings in a public space are often difficult since they violate a user's privacy. For example, a camera in a workplace may allow the time to be determined when an employee arrives at work or leaves the office. As a result, video installations usually require signage to make the user aware of the use of cameras, which, in turns, may lead to unnatural behavior.

In this work we set out to address the aforementioned challenges by building a tool that allows the scenes in a display vicinity to be recorded and replayed while preserving the user's privacy. In particular, our tool processes anonymous, time-stamped interaction data about a user – in the cur-

rent implementation we use the user position in front of the display (x and y coordinate) as well as the skeleton data, as can be obtained from Microsoft Kinect. Data can be obtained from one or multiple Kinects observing the scene in front of a display. We then create a virtual representation of the scene, consisting of the location of the display as well as the position and current body posture of all users. Since all data is time-stamped, we can replay the scene at arbitrary speeds and from arbitrary angles, thus providing users of our tool a powerful means to understand what is going on in the vicinity of a deployment.

Our tool is meant for (a) researchers who want to investigate the effect of an intervention on the audience (e.g., employing a novel interaction technique) and for (b) practitioners who want to analyze the success of their deployment and react to any issues. For example, a display may be used for very short amounts of time only. Using our tool it would be possible to find out that due to the deployment along a well-frequented walkway, passersby constantly bump into people interacting, leading to that the latter stop interaction and leave the display. Or a display may only support single-user interaction but be deployed in a situation where users usually appear in groups (a cinema). As a result, some of the group members may leave soon, causing those people interacting to leave as well.

Our demonstration will focus on showcasing a large variety of situations in which the tool could be useful, drawing from both previously recorded data as well as on data that is recorded at the conference. Note, that our work is not specific to public displays – we rather consider this as one of the major use cases. By demonstrating this work at CHI we hope to make other researchers and practitioners aware of this tool and are planning to release this to the community in the future.



Figure 2: Our tool supports multiple modes and observational perspectives. An environmental view (a) allows the scene to be observed as if deploying a camera, whereas a user view (b) allows the visual field of view of a person interacting to be explored. In replay mode, researchers can replay the scene at arbitrary speed, whereas the static mode allows trajectories and heat maps to be visualized and analyzed.

The Anonymous Audience Analyzer

Our audience analysis tool provides a large set of features that will be at the focus of the demonstration. In particular, we will show how to use analysis vs. replay mode and how to use different observational perspectives.

Modes

In the *replay mode*, researchers are able to observe the movement and behavior of one or multiple users. By allowing individual users to be displayed, researchers are free to either focus on the behavior of a single user or group of users without being disturbed by other passers-by (e.g., development of some social interaction between two users who did not know each other previously) or the researcher can investigate the external influence of passersby and their interplay with the persons interacting (e.g., stopping in a second row and observing the interaction, creating a honey-pot effect).

The *analysis mode* allows the trajectory of users to be visualized (similar to [7]). Hovering over the different data points that constitute the trajectory, researchers can obtain information on the current time and shoulder orientation.

We see the ability to switch between the different modes and toggle on and off the visual display of one or multiple viewers as one of the major strengths of our approach compared to a traditional video representation.

Observational Perspectives

Both in replay mode and analysis mode, our tool provides four observational perspectives:

- The *environmental view* allows researchers the scene to be observed from a camera that is located in an arbitrary position in the display vicinity.
- The *display view* provides fast access to a view of the scene from a camera deployed directly at the display.
- A *person view* allows a scene to be observed from the view of a bystanders or one of the persons interacting. Thereby the viewing direction matches the head pose obtained from the Kinect data. Though being only a coarse estimation, we envision this view to be another strengths of our tool, since this information is not available from video data.
- The *gaze point of view* allows researchers to see the orthodox position of eye focus on the display.

Demo Setup

At the CHI conference we will show a demo of the audience analysis tool on a large display. Visitors will be able to explore four sample data sets using the different visualization modes and observational perspectives.

We will provide the following data sets: The first data set was recorded at an Open Lab Day of our University whereas the second data set stems from an in-the-wild deployment in one of our faculty buildings. Both deployments featured a Kinect-based game where up to 6 users can collect items on the screen by touching them with their hands. Both deployments strongly differ in location and audience. Whereas the first data set comprises interaction data from (both tech and non-tech savvy) visitors at the Open Lab Day and was recorded in a room of approximately 30 square meters, the second data set was recorded in an open space with tables and seats where students, mainly from communications science, meet for working on assignments.

The third data set is from a trade fair, where we deployed an interactive, Kinect-based Puzzle game where multiple people could solve a Puzzles on the screen to obtain more information on the shown object. The display was deployed in a booth of a museum. The audience consisted of the visitors of the trade fair with a large variety of backgrounds.

For the fourth data set we plan to record visitors at our booth at the first day of CHI 2016.

Conclusion

With our tool we hope to provide a powerful means to supports researchers and practitioners working in public environments. The goal of our demo is to showcase the strength of the tool to visitors and hope that upon public release this will become useful for the community.

Furthermore, we hope to identify additional use cases and receive ideas for new features.

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