

Designing methods for more identity-obscuring and equitable sensing in shared spaces

Andrew Xu, Jacob Biehl, Adam Lee

Motivation

Success of infrastructure-sensing will depend on fair and equitable use of the data.

- Shifting to smarter buildings and spaces comes at the cost of privacy
- Benefit of space sensing is not equitable to all stakeholders of the space
- Privacy-obscuring measures are necessary to preserve people's trust in public, shared spaces

Formative Assessment

Research Question: Can we design and create identity-obscuring visualizations that reveal information about space usage while still maintaining user privacy?

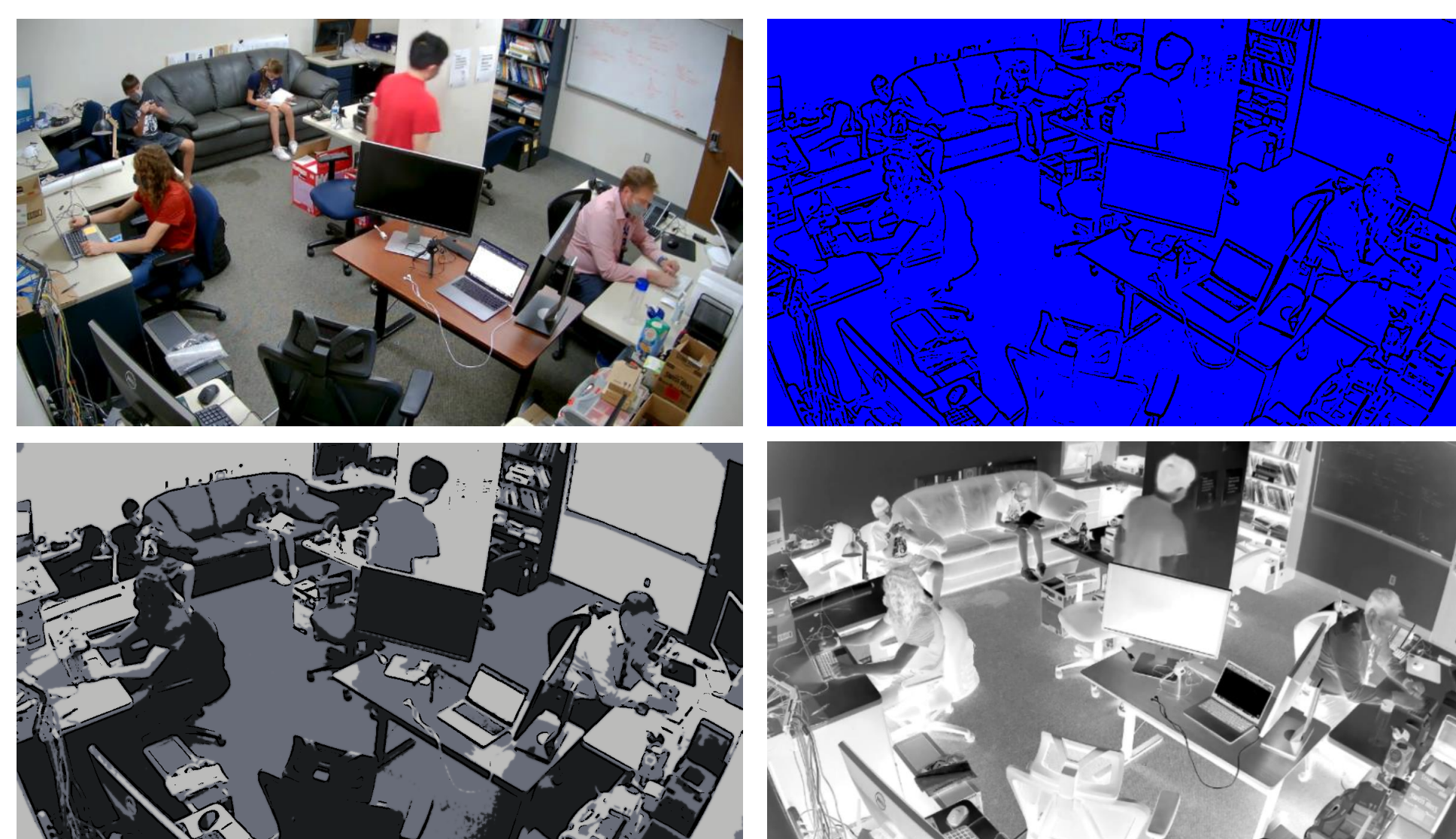
Mixed methods inquiry

1. Semi-structured interview (n=12)

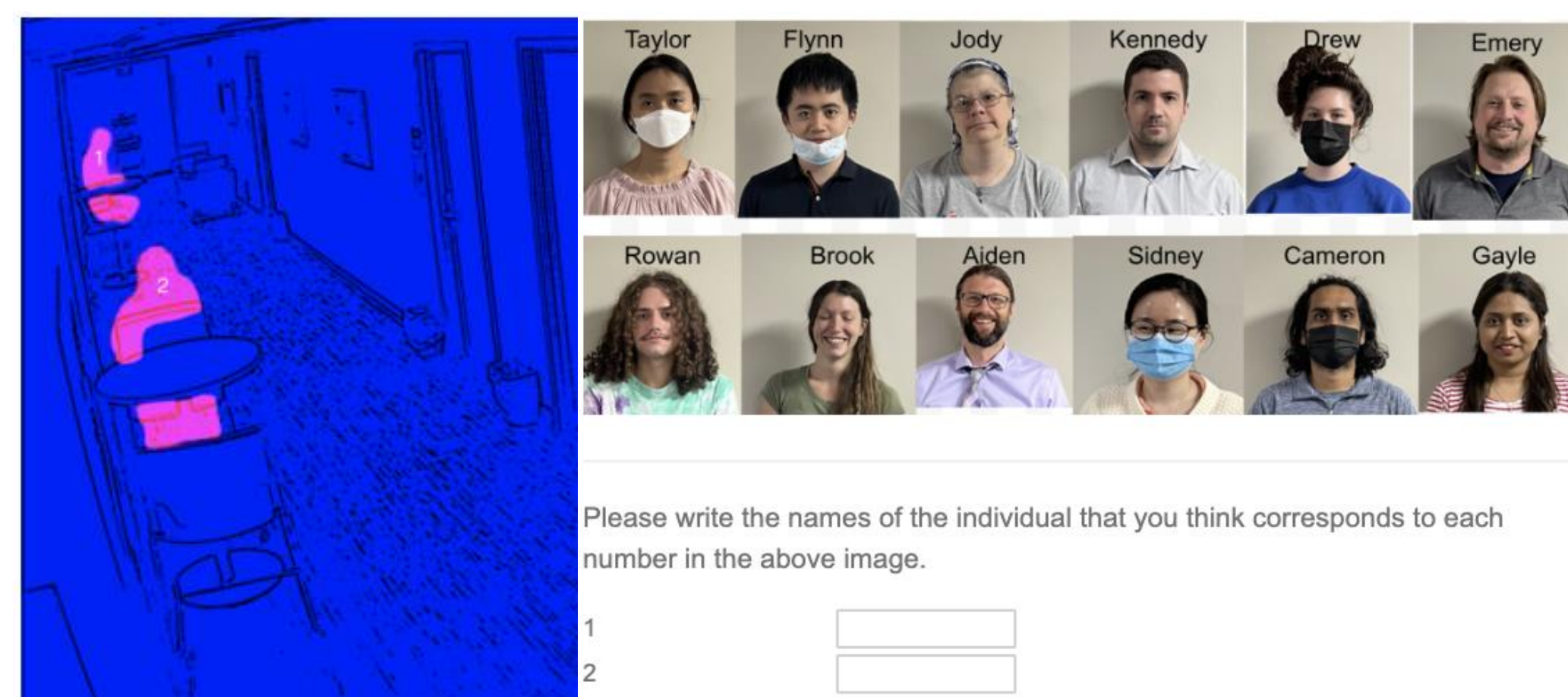
- Online survey of privacy concerns and comfortability with different visualizations
- Lab demonstration of the visualizations in real-time
- Discussion of different parameters in the visualizations and participant sentiment

2. Amazon Mechanical Turk survey (n=100)

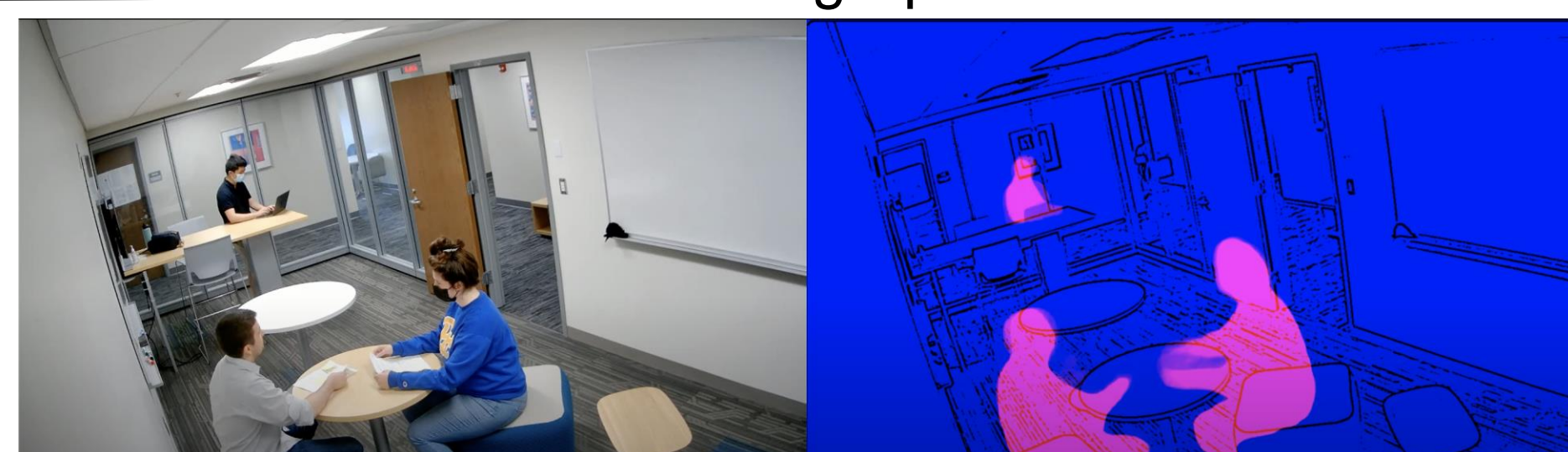
- Created vignettes with 12 actors across two spaces on normal activities in the spaces
- Online survey measuring how well visualizations obscure identities across the vignettes while still conveying information about space usage



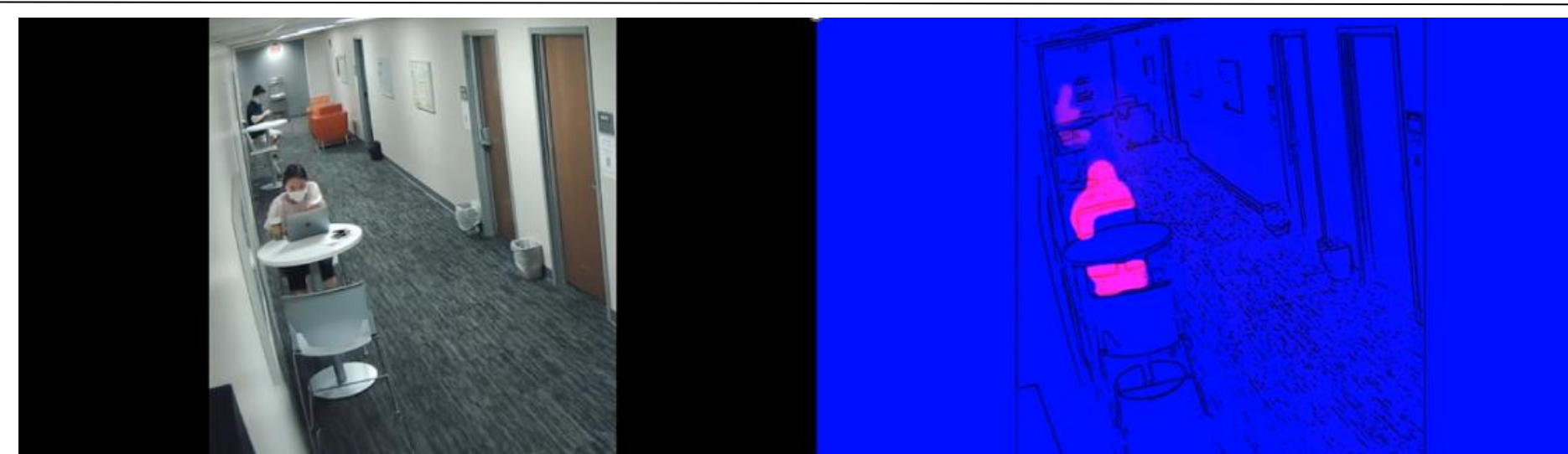
Four types of visualizations. In order clockwise from the top-left: raw image, line filter, cartoon filter, inverted filter



A sample identification task given to the Mechanical Turks with only headshot image provided



Study room vignette of a group of 2 talking and a third individual working



Hallway vignette of two individuals working

Results

- Participants could only identify actors correctly 7.9% of the time
- Top four most frequently guessed actors were not actually in any scenarios
- Between most pairs of actors, there was no significant difference in identification accuracy

Table 1: Statistics of headshot versus full-body images of actors

| | Precision | Recall | F-score |
|-----------|-----------|--------|---------|
| Headshot | 0.0986 | 0.0867 | 0.0922 |
| Full-body | 0.0841 | 0.0747 | 0.0791 |

Table 2: Open-response accuracies across different vignettes

| Vignettes | Number of groups | Group size | Qualified Responses |
|--------------|------------------|-------------|---------------------|
| Study room 1 | 80/82=0.976 | 76/82=0.927 | 86/90=0.956 |
| Study room 2 | 77/80=0.9625 | 72/80=0.9 | 82/86=0.953 |
| Study room 3 | 87/87=1.0 | 87/87=1.0 | 87/87=1.0 |
| Hallway 1 | 81/82=0.988 | 79/82=0.963 | 80/83=0.964 |
| Hallway 2 | 67/68=0.985 | 45/68=0.662 | 73/73=1.0 |
| Hallway 3 | 71/77=0.922 | 37/77=0.481 | 77/77=1.0 |

Future work

- Design and create interventions that allow users to directly interface with and benefit from behavioral data collected about shared spaces
- Examine whether these interventions make space use more equitable
- Explore how our systems impact and improve upon how spaces are designed