

# Pragmatic Privacy Controls in an Era of Sensor-Enabled Computing

**APU KAPADIA, INDIANA UNIVERSITY**



# Privacy in the Age of Pervasive Cameras

When Electronic Privacy  
Gets Physical

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# A Socio-Technical Approach to Privacy in a Camera-Rich World

Apu Kapadia, David Crandall, Denise Anthony  
Indiana University and Dartmouth College

NSF Awards: CNS-1408730, CNS-1407788

## Challenge

**Wearable cameras** enable novel lifelogging applications, but raise significant **privacy** and surveillance implications for individuals and society

## Approach

We propose an integrated research plan that couples **sociological** investigations of people's privacy perceptions and needs with **technical** investigations privacy-sensitive visual sensing techniques

## Key Results

Sociological study to **understand privacy concerns** of lifeloggers (UbiComp 14, CHI 15):  
places, objects, impressions



PlaceAvoider algorithm to **detect where** a photo was taken with high accuracy (NDSS 14) ScreenAvoider to **detect computer screens** with high accuracy (CHI 16)

## Scientific Impact

Our work contributes to the privacy literature by studying how social context influences people's **perceptions and expectations of privacy** for images and **automated algorithms** to infer objects and situations captured in images that may breach privacy.

## Broader Impact

Our socio-technical approach has the potential for **positive societal impact** by improving visual computing applications while recognizing differences in desire for privacy **across social groups**, and to then build technical mechanisms for **privacy control**. Additionally, our internship program has involved students from **underrepresented minorities** in the research.

Project Homepage:

<http://private.soic.indiana.edu/projects/cameras/>

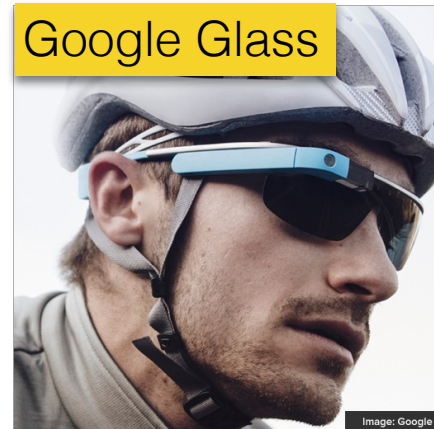
# New 'lifelogging' cameras for capturing moments

Narrative Clip



<http://www.getnarrative.com>

Google Glass



<http://www.google.com/glass>

Vuzix



<http://www.vuzix.com>

Autographer



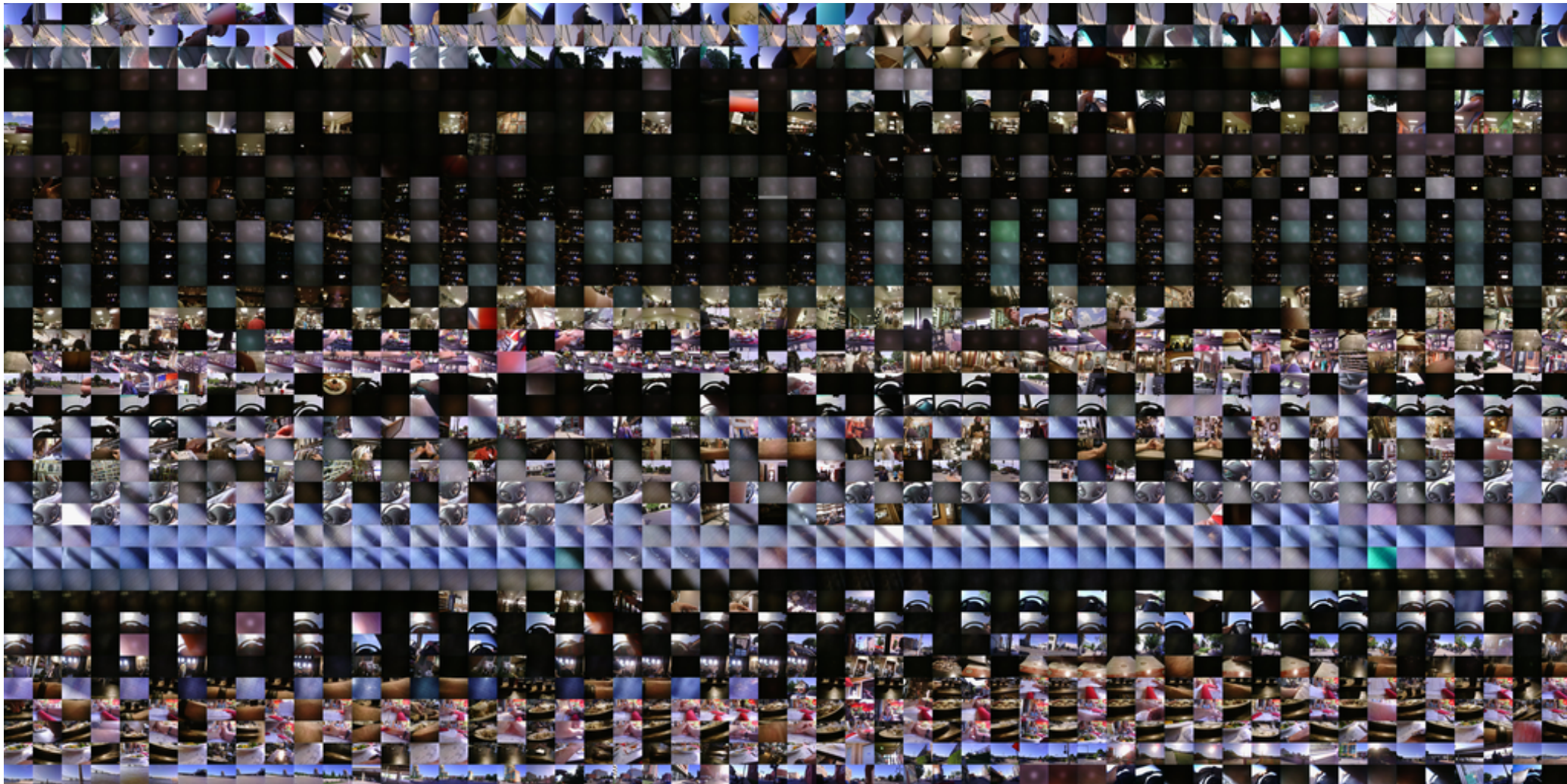
<http://www.autographer.com>

Gear



<http://www.samsung.com/global/microsite/galaxynote3-gear/>

# 'Tivo'/DVR your life



# Document interesting moments



# And much more



<http://www.siliconbeat.com>  
**Law enforcement**



<http://www.digitalavmagazine.com>  
**Assist with surgery**



<http://blog.memoto.com>  
**Therapeutic use**

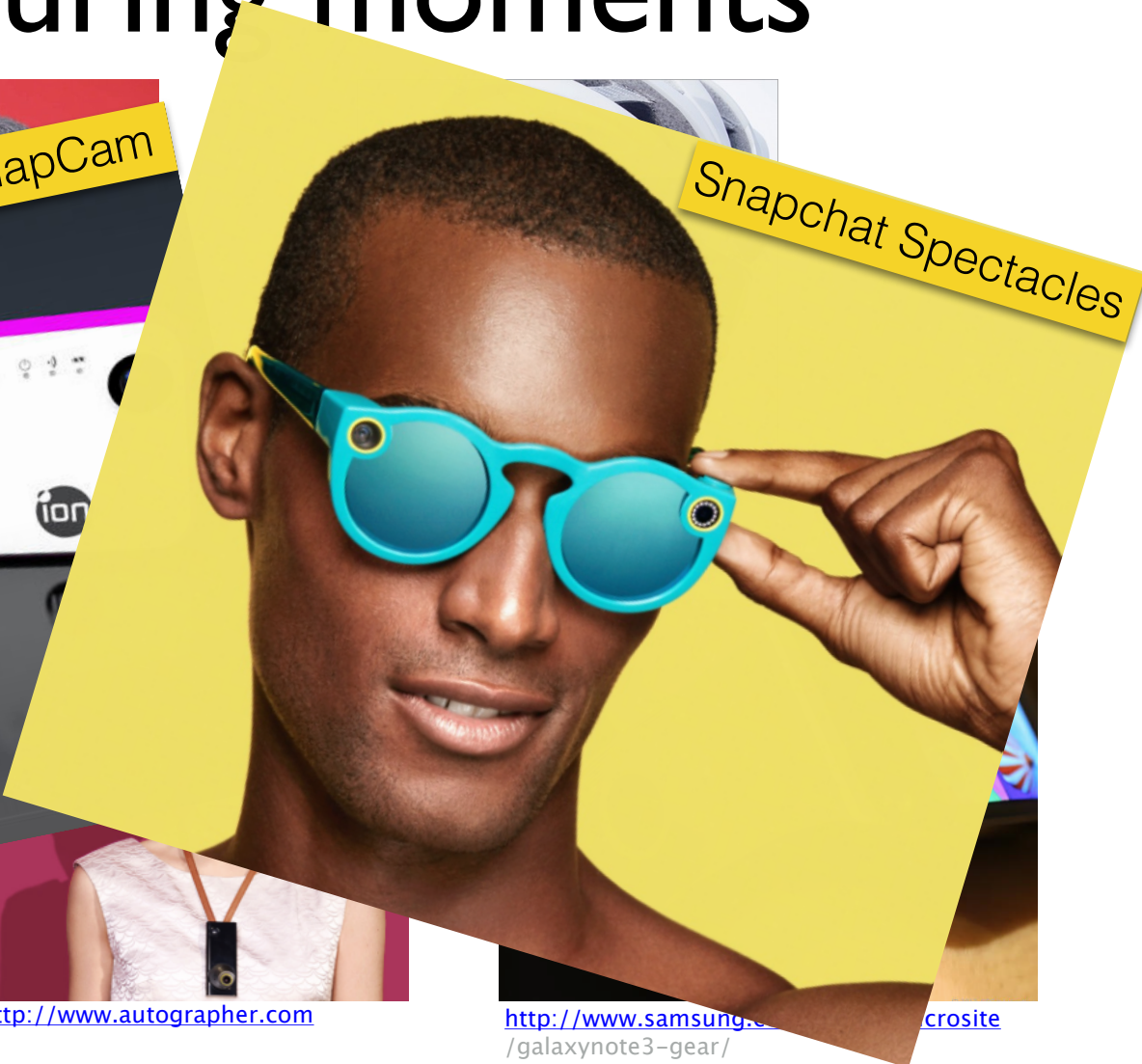
# Newer first person cameras for capturing moments

iON SnapCam



<http://www.vuzix.com>

Snapchat Spectacles



<http://www.autographer.com>

<http://www.samsung.com/crosite/galaxynote3-gear/>



# Newer first person cameras for capturing moments



Google Clip

Snapchat Spectacles

<http://www.vuzix.com>

Google

crosite

/galaxynotes-year/

# How will such collection affect our privacy?



# Need generalizable privacy controls for wearable cameras

## Faculty

Apu Kapadia (Computer Security and Privacy)  
David Crandall (Computer Vision)  
Denise Anthony (Sociology, Dartmouth College)



Narrative

## PhD Students

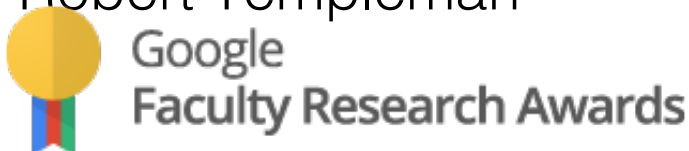
Tousif Ahmed  
Rakibul Hasan  
Roberto Hoyle  
Qatrunnada Ismail  
Mohammed Korayem  
Robert Templeman

## Undergrads

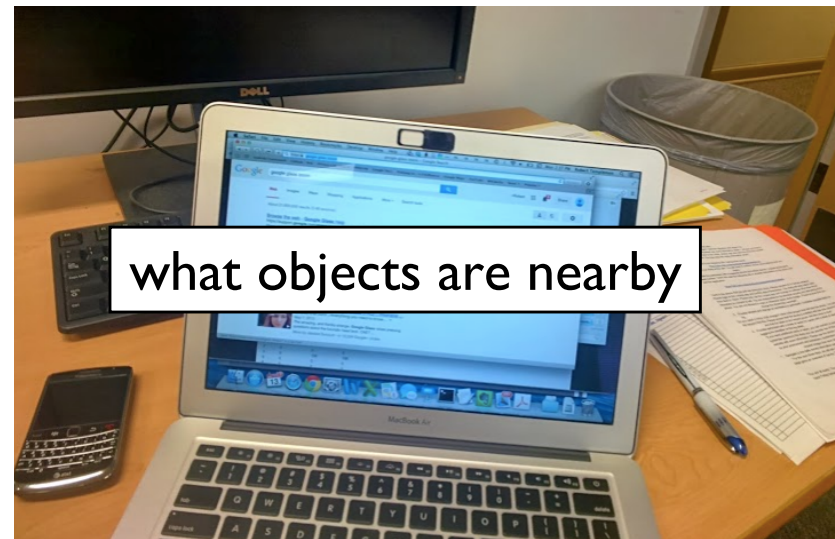
Steven Armes  
Emily Fath  
Felicia Patel



Google



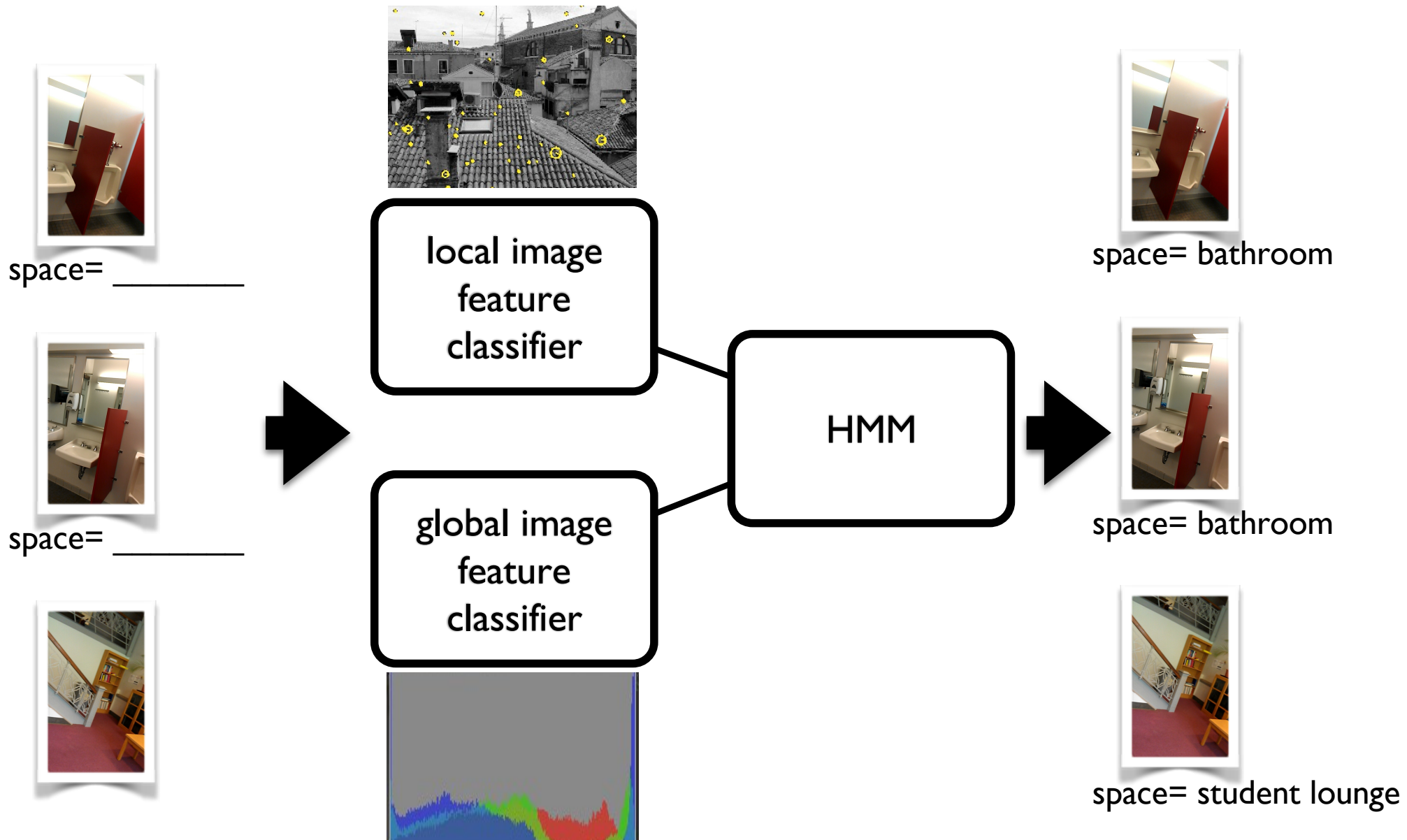
# What makes an image sensitive?



# Detecting sensitive spaces with **PlaceAvoider**

Robert Templeman, Mohammed Korayem, David Crandall, and Apu Kapadia,  
"PlaceAvoider: Steering First-Person Cameras away from Sensitive Spaces,"  
The 21st Annual Network & Distributed System Security Symposium (**NDSS**  
'14)

# Landmarks and General Characteristics

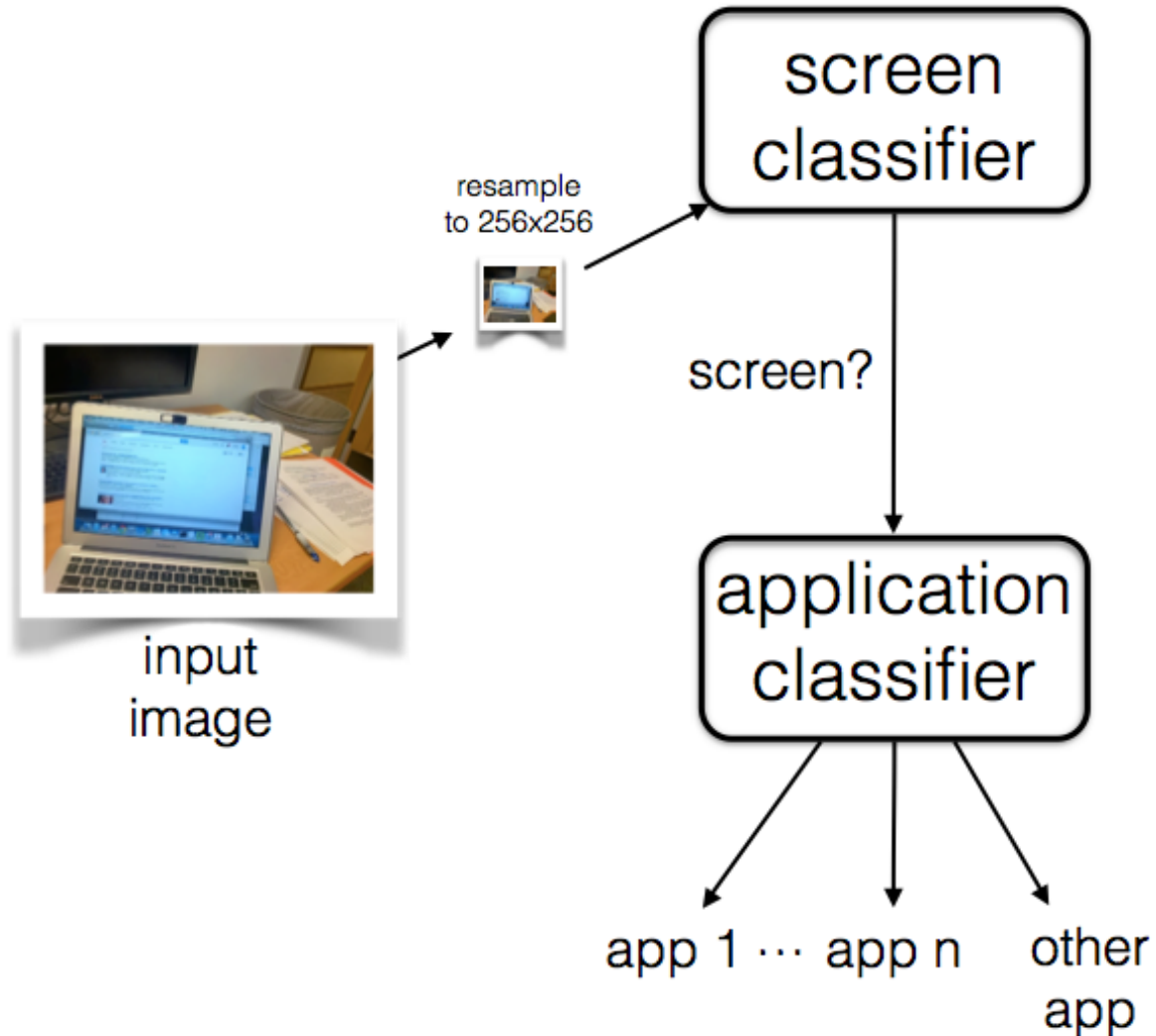


# Detecting screens with...

# **ScreenAvoider**

Mohammed Korayem, Robert Templeman, Dennis Chen, David Crandall, and Apu Kapadia, "Enhancing Lifelogging Privacy by Detecting Screens,"  
To appear In Proceedings of The ACM SIGCHI Conference on Human Factors in Computing Systems (**CHI '16**), Honorable Mention Award.

# Is the screen displaying sensitive content?





# Can we help **visually impaired** people **assess** their privacy?

**Tousif Ahmed**, Roberto Hoyle, Kay Connelly, David Crandall, and Apu Kapadia,  
"Privacy Concerns and Behaviors of People with Visual Impairments,"  
ACM SIGCHI Conference on Human Factors in Computing Systems (**CHI '15**)

**Tousif Ahmed**, Patrick Shaffer, Kay Connelly, David Crandall, and Apu  
Kapadia,  
"Addressing **Physical Safety, Security**, and Privacy for People with Visual  
Impairments," Twelfth Symposium on Usable Privacy and Security (**SOUPS**  
**'16**)

# Several unmet privacy needs



Who's around me?



Who's reading my screen?



Can they hear me?



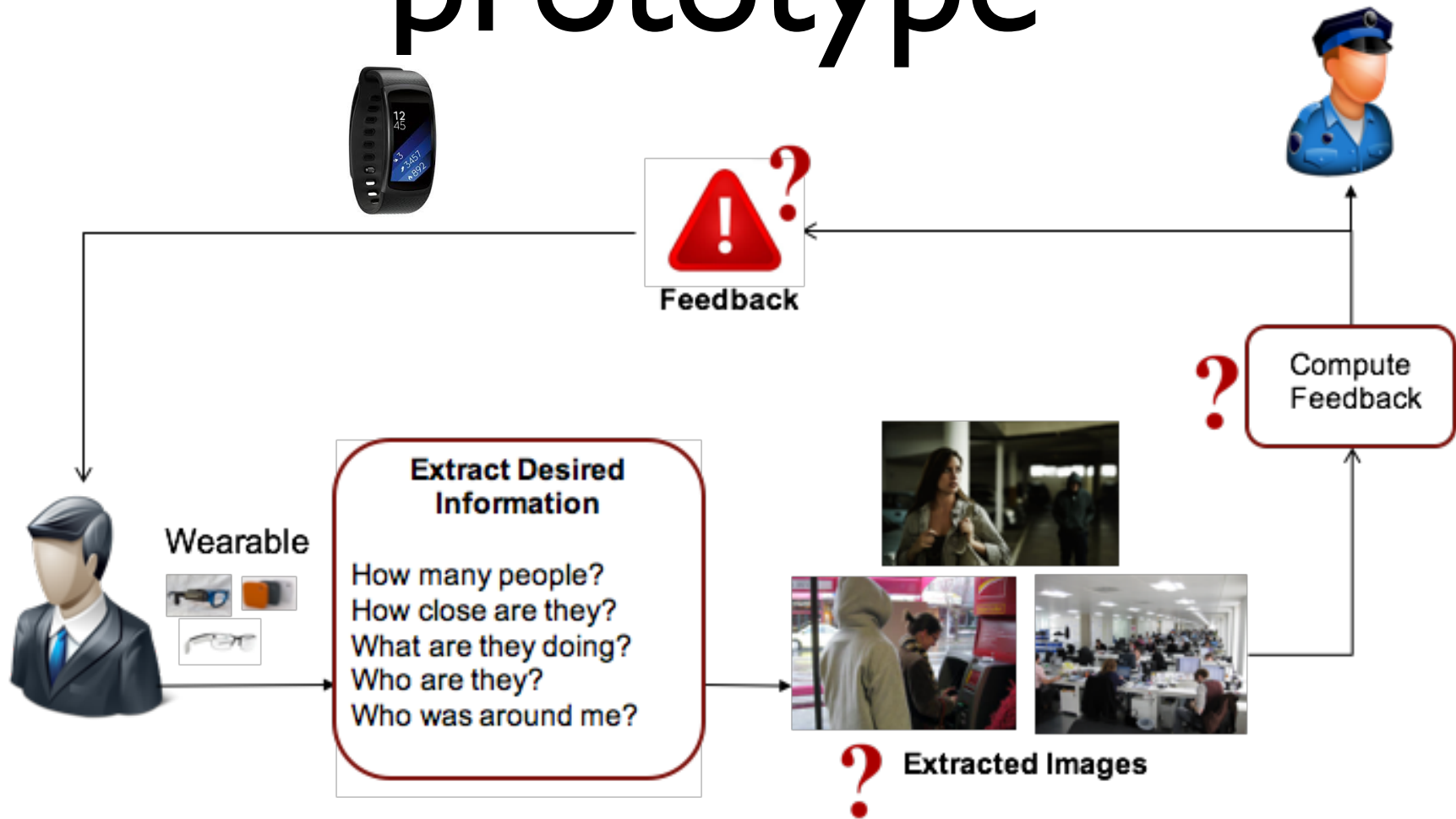
Am I being recorded?

# Are people too close to me?

“Privacy bubble”



# Currently designing a prototype





Google  
Faculty Research Awards



**INDIANA UNIVERSITY**  
SCHOOL OF INFORMATICS AND COMPUTING  
Center for Security Informatics  
Bloomington

***TWC SBE: Medium: Collaborative: A Socio-Technical Approach to Privacy in a Camera-Rich World***

With: David Crandall (IU) and Denise Anthony (Dartmouth)  
NSF CNS-1408730, 1407788. \$1.2M

***CAREER: Sensible Privacy: Pragmatic Privacy Controls in an Era of Sensor-Enabled Computing***

NSF CNS-1252697. \$559K

***Privacy-Enhanced Life-Logging with Wearable Cameras***

With: David Crandall (IU)  
Google Research Award. \$46K

***FRSP Type II: Vision for Privacy: Privacy-Aware Crowd Sensing Using Opportunistic Imagery***

With: David Crandall (IU)  
Office of the Vice Provost of Research at Indiana University Bloomington. \$50K

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