Privacy Enhancing Framework to Advance Models of Behavior

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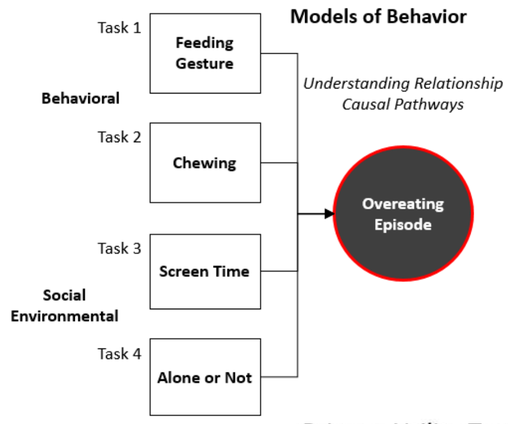
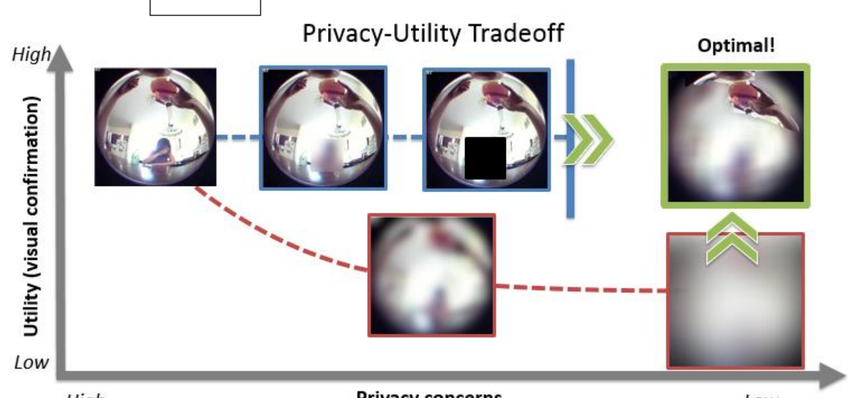




Motivation

- Behavioral science: Understanding human behavior is primarily based on biased/burdensome self-report
- Wearable cameras:
  - Provide visual confirmation of everyday behaviors, including overeating in real-world settings
  - Capture privacy-sensitive context, preventing wearers' naturally occurring behavior
- *Can we design a wearable camera that enables visual confirmation of wearer's behavior, while reducing privacy concerns of recorded data?*

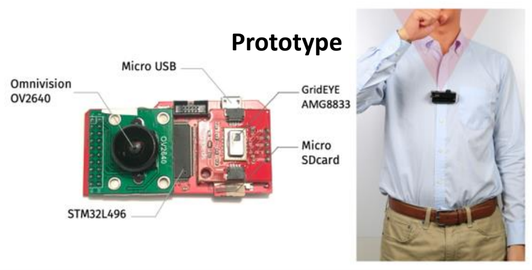
Challenges

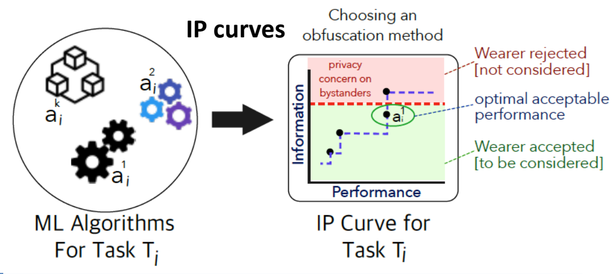
- **Reduce complexity** of activity-recognition algorithms to run on resource constrained devices
- **Develop activity-recognition algorithms** that run on obfuscated video sequences
- **Evaluate** which **algorithms** can run in-situ and which can run offline
- **Ensure acceptability** of a wearable device that people are willing to wear and provides visual confirmation of wearers activities
- **Automate obfuscation** of sensitive content
- **Design device to function in real-world settings**

Scientific Impact

The developed system will be useful for:

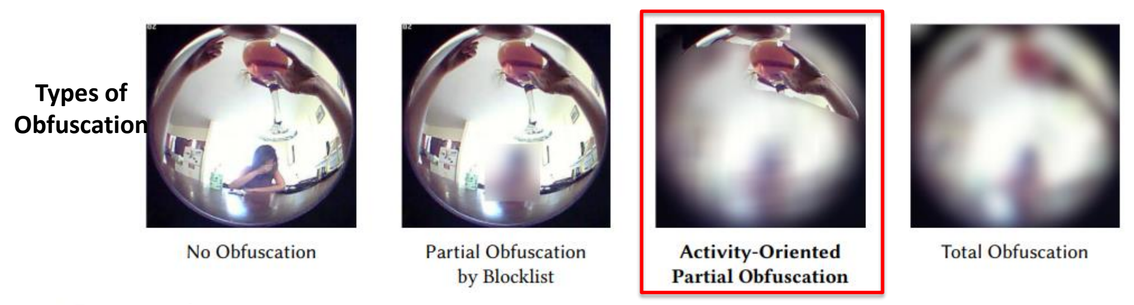
- **Solving challenges** in **resource allocation** of image processing **algorithms**
- **Accelerating** design and adoption of **objective measures** in understanding human behavior
- **Advancing understanding** of trade-off between **privacy** and **utility** of a wearable video cameras by creating **Information-Performance curves** (IP curves)

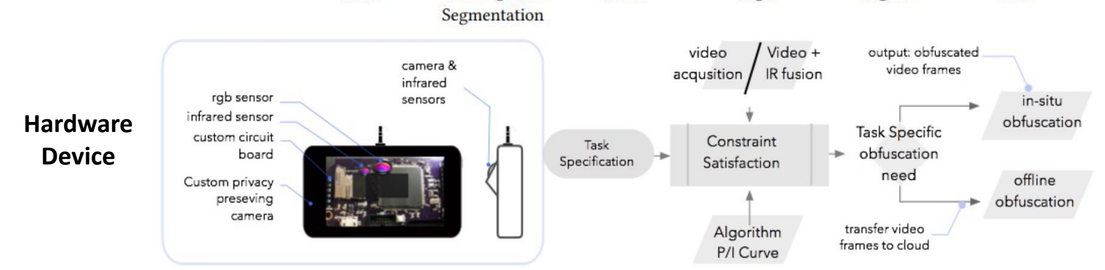




Solution

- **Design a suite of** computationally efficient task-specific **algorithms** that run (in-situ) on raw video images and obfuscated **activity-oriented partial obfuscation** images in unrestrictive environments (offline) to detect behaviors related to eating
- **Determine acceptability** of obfuscation methods
  - **Design IP curves** for the scalable development of cameras that protects privacy
  - **Data Collection**: Use data collected from a fisheye lens enabled RGB camera and infrared sensor array and test privacy and visual confirmation to build information-performance curves
- **Develop** low-complexity, configurable, modular and efficient obfuscation **wearable system**
  - **Optimize resource allocation** of machine learning algorithms in-situ or offline to detect overeating





Broader Impact

Reshaping Social, Behavioral, and Economic Sciences: Behaviors are not properly understood in free-living conditions. This device will reshape our ability to understand human behavior related to health (eating, smoking), social (human interactions with the environment), and economic (consumer behavior) sciences

Understanding the information-privacy tradeoff: Problematic eating (e.g., overeating or binge eating) often occur in isolation. This tool will help improve the understanding about how much information is necessary to visually confirm and automatically detect the problematic behavior while preserving people's privacy

Advancing capability of resource constrained wearable cameras: Developing efficient algorithms that can find provable tight upper bounds for system performance in-situ and offline (on obfuscated images), while providing a computational framework to accelerate adoption of wearable sensors