



## *Privacy and Social Consequences of Wearable Computing*

Prof. Feiner

COMS E6176

Columbia University

New York, NY 10027

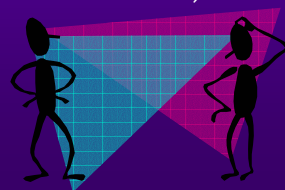
May 4, 2004

1



## *Social Influences on Tracking Accuracy*

- ◆ Strength in numbers. . .
- ◆ Collaborative tracking
  - ◆ Release personal info to help others (e.g., own hand position)
  - ◆ Release info about other user's hand (to help her if obscured from her tracker)



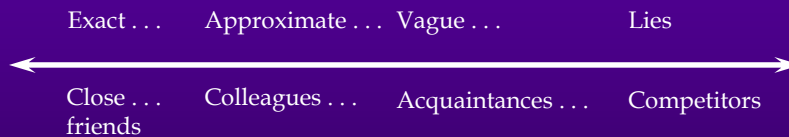
2



## Social Influences on Tracking Accuracy

- ◆ Even with “perfect” tracking, *need to know* vs. *need to let know* will influence accuracy, precision, update rate, . . .

- ◆ *Transmitting* – Filter based on recipient



- ◆ *Receiving* – Filter based on transmitter

3



## Appearance and Comfort

- ◆ “Location, location, location”
  - Three most important factors in real estate?
- ◆ “Registration, registration, registration”
  - Three most important factors in AR?
- ◆ Many useful AR apps require *no* registration and trivial sfw, yet don’t exist yet!
  - ◆ clock
  - ◆ caller ID
  - ◆ notes

4



## *Appearance and Comfort*



**It's the display, stupid!**

5



## *Appearance and Comfort*

◆ Head-~~mounted~~ display  
worn



6



## *Mobility Breeds Collaboration*

- ◆ Computational interaction should be as easy as social interaction
- ◆ How many CS professors does it take to connect two laptops. . .
  - ◆ with ethernet?
  - ◆ with IR?
- ◆ Overload current human-human interaction to initiate computational interaction

9



## *Integration with Other Devices*

- ◆ User's head-worn display coexists with
  - ◆ *user's other* displays/devices
  - ◆ *other users'* displays/devices
  - ◆ *stationary* displays/devices

10



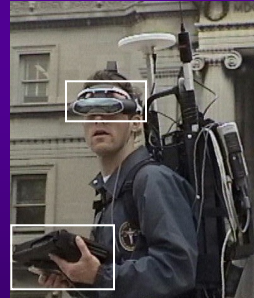
## Hybrid User Interfaces

- ◆ Combine technologies to create *hybrid UI* that benefits from best of all

◆ 2D	3D
◆ opaque	see-through
◆ held	worn
◆ large	small
◆ stationary	mobile
◆ permanent	temporary

...

...



11



## Implications for Personal Privacy

- ◆ User tracks world (wearable computing)

vs.

~~world tracks user (smart environment)~~

- ◆ Does this solve the problem?

- ◆ No: "vs." will really be "and"

- ◆ Parts of the world *will* track the user precisely because some users won't release their information and others will profit from providing it

12



## *Implications for Personal Privacy*

Wearable cameras/mics

- ◆ tracking
- ◆ recording personal experience
- ◆ context-sensitive UIs
- ◆ small/inexpensive

+ Wearable storage/wireless networking

- ◆ high capacity/throughput

---

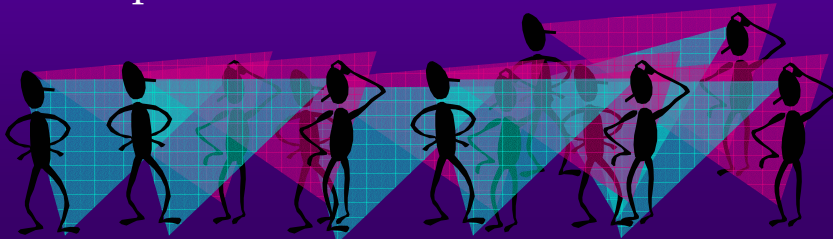
= Potential for violating privacy

13



## *Implications for Personal Privacy*

- ◆ Current approach to cyborg privacy violation:  
“Just say no.”
- ◆ But what happens when everyone can capture, record, and transmit?



14



## Implications for Personal Privacy

- ◆ “Safety net” (Mann)
  - ◆ Groups of users “watch out” for their members, coming to their aid if needed
  - ◆ Users
    - ◆ “watch the watchers”
    - ◆ keep an eye on Big Brother



15



## Implications for Personal Privacy

- ◆ Organization X pays users for real-time access to their experiences
- ◆ Users can control access
  - ◆ Expurgate interactions at home/work, with close friends, . . .
  - ◆ Feel their privacy is preserved



16



## *Implications for Personal Privacy*

- ◆ Organization X reconstructs for a buyer any person's activities
  - ◆ harvests isolated time/ space-stamped bits of interaction overheard/ seen in passing by others
  - ◆ assembles bits to recreate significant/ useful portions using massively parallel multimedia processing
- ◆ Price paid to free agent users based on
  - ◆ user's proximity to events/ people of interest

17



## *Implications for Personal Privacy*

- ◆ User's wearable agents handle bidding with competing organizations if user isn't under contract
- ◆ Subject of surveillance may buy others' silence, but many may already be under contract
- ◆ Information gatherers not shady underworld infobrokers, but "just plain folks"

18





## *Implications for Personal Privacy*

- ◆ Not misappropriation of user's video/audio likeness
- ◆ Low-tech private-eye version happens now, but. . .
  - ◆ expensive, requires serious human effort
- ◆ High-tech net version happens now, but. . .
  - ◆ limited to info in databases
  - ◆ may even have subject's consent (freepc.com)

19



## *Implications for Personal Privacy*

*What will keep this from happening?*

20



## *Conclusions*

- ◆ Social influences on tracking accuracy
- ◆ Appearance and comfort
- ◆ Mobility breeds collaboration
- ◆ Integration with other devices
- ◆ Implications for personal privacy