

Ubiquitous and Mobile Computing

CS 403x: A Survey of Mobile Phone Sensing

Zachary Arnold, Joseph Spicola, &
Tyler Stone

*Computer Science Dept.
Worcester Polytechnic Institute (WPI)*





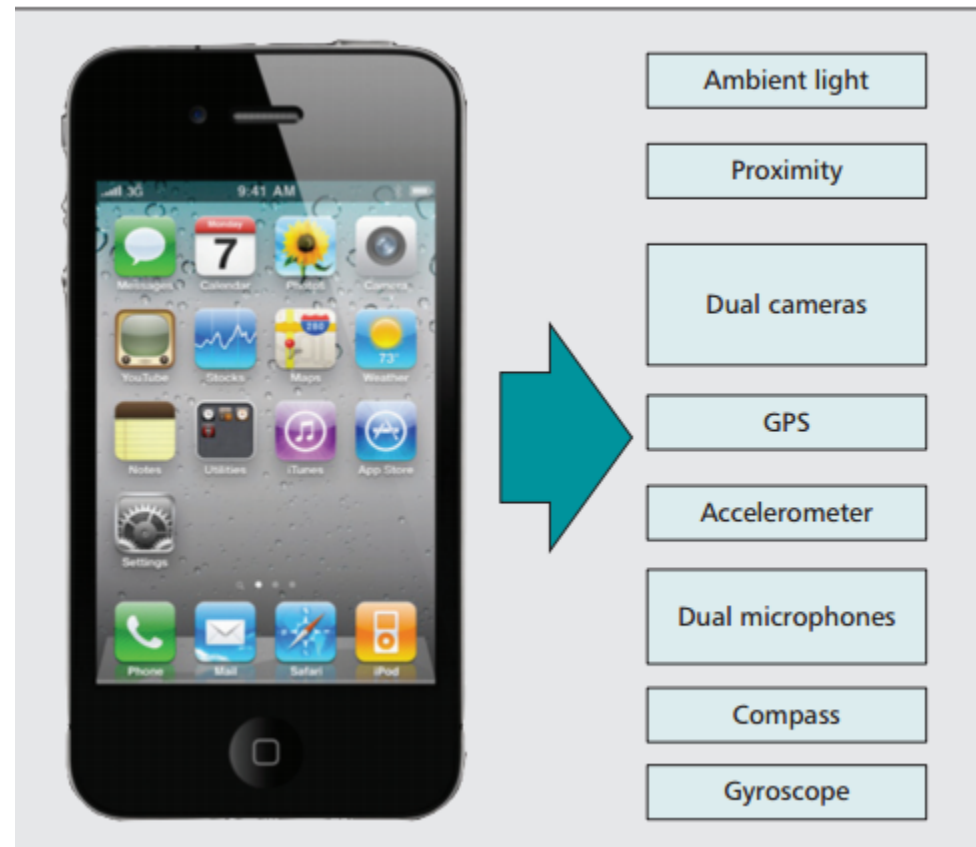
Introduction

- Mobile phone sensing is rapidly changing the way data is collected
- Sensors have enabled phones to become more than just mobile computers
 - They are now able to perceive their environment in multiple ways
- These perceptions can be useful in making determinations about the user and/or the phone's environment



Sensor Overview

- The number of sensors increases with each new phone release
- Each addition makes the phone more capable of sensing its environment in the same way a human might



Advances in Environment Sensing

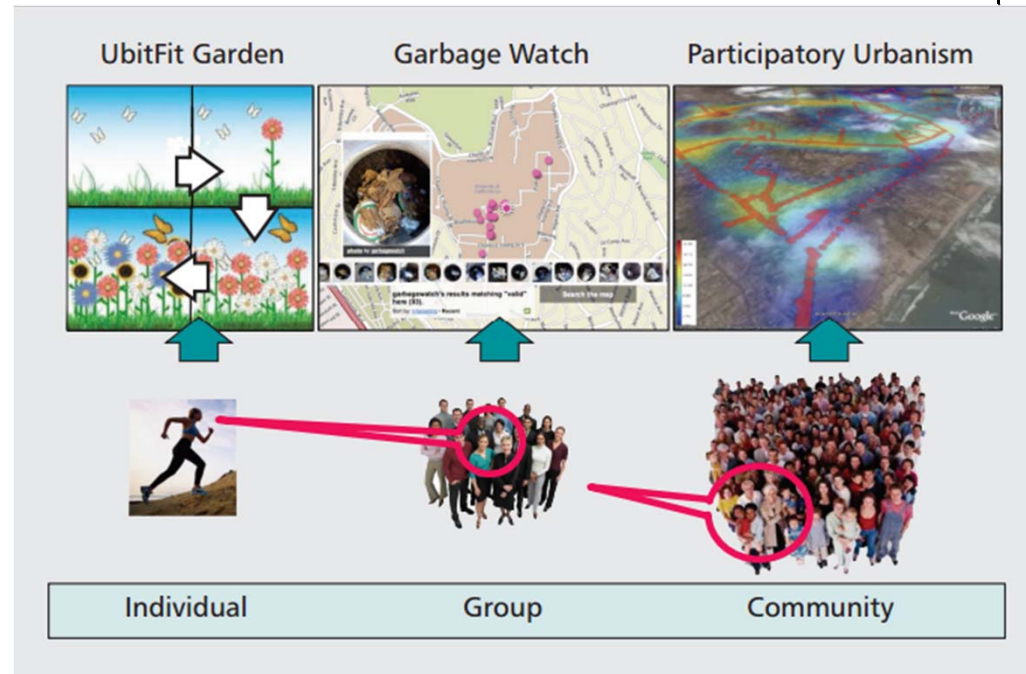


- Hardware manufacturers have made sensors easier to obtain than ever before
- Programmers can develop apps that use these sensors in real time
- Software developers are able to make sensor based apps available to the public through the “app store”
- The cloud allows for increased processing power, and greater data storage



Sensing at Scale

- Individual
- Group
- Community

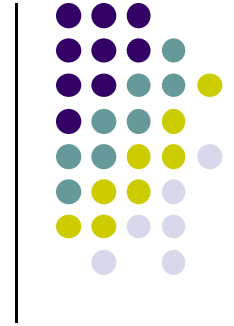


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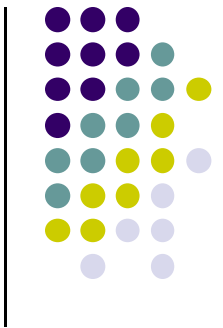
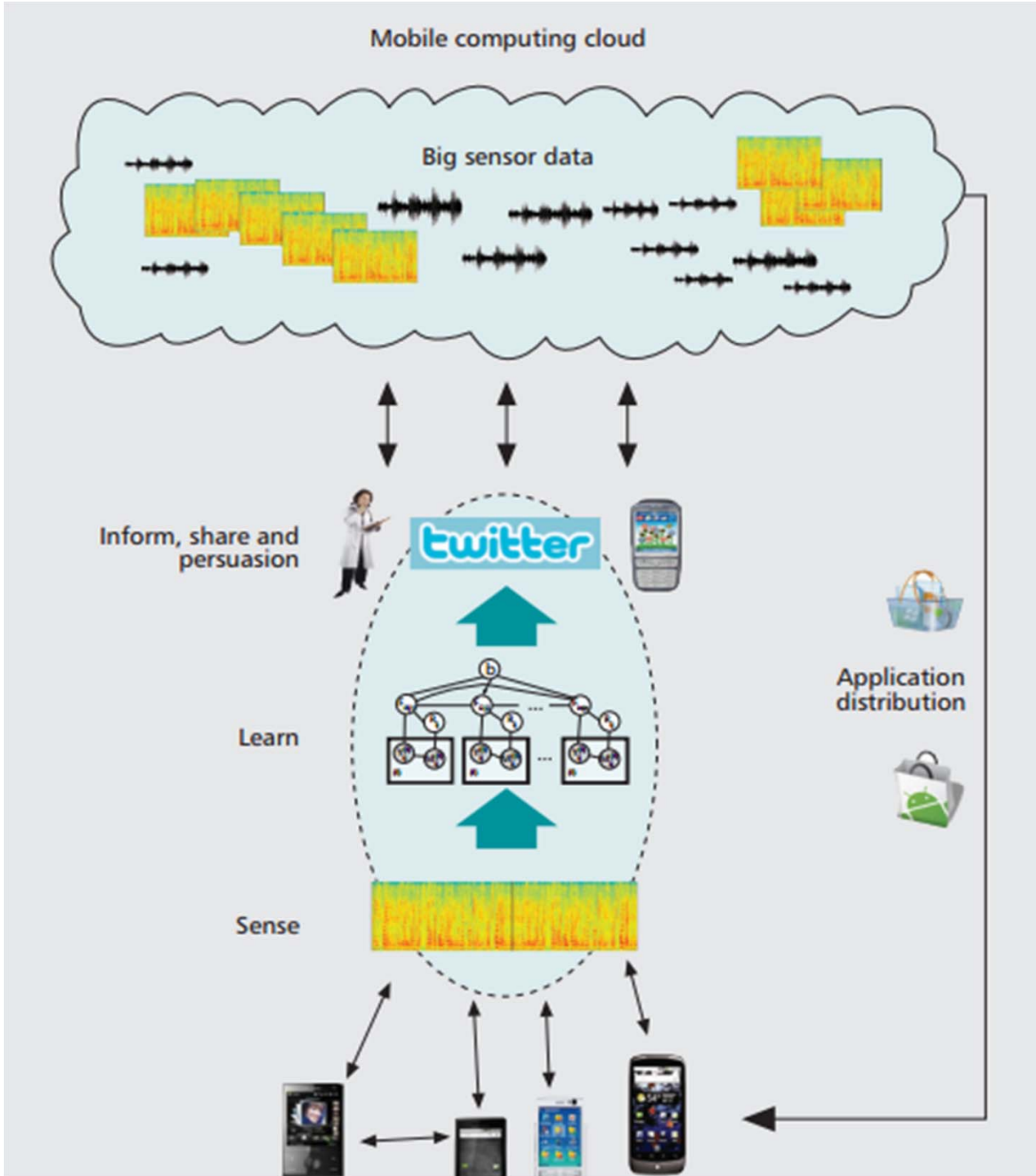
Sensing Paradigms



- Participatory Sensing
 - User input is used to aid collection of data
- Opportunistic Sensing
 - Only sensors are used to collect data



PROPOSED SENSING ARCHITECTURE



Mobile Phone Sensing Architecture: Sense



- Programmability
 - Cost of integrating a sensor (or multiple) into an application
 - Sampling, API's, OS requirements
- Continuous Sensing
 - Leverages background processes of the phone
 - Provides a way for applications to respond in real-time
- Phone Context
 - Where is the phone, and how does it affect sensing?

Mobile Phone Sensing Architecture: Learn



- Human behavior and context modeling
 - Raw sensor data is interpreted and analyzed to identify features
 - Done locally or in the cloud
 - Data mining, machine learning, etc.
- Scaling Models
 - Crowdsourcing data, and making inferences about a population

Mobile Phone Sensing Architecture: Inform, Share, Persuasion



- Use the processed data
- Examples:
 - Inform:
 - Notify users of accidents (Waze)
 - Share:
 - Notify friends of fitness goals (MyFitnessPal)
 - Persuasion
 - Help avoid speed traps by slowing down (Waze)



Future Considerations

- Privacy vs. resources
- New, different types of sensors
- Limited resource pool vs. # of sensors
- The role of Artificial Intelligence in decision making based on sensor data



Conclusions

- Mobile phones are becoming a major source of information
- Sensor data can be used in powerful, beneficial ways on an individual, group, and community level
- Sensor data can be used with malicious intent
- Privacy, phone resources, ethics are still major issues in phone sensing



References

- [1] N. D. Lane *et al.*, “A Survey of Mobile Phone Sensing,” *IEEE Communications Magazine*, 2010, pp. 140-150.