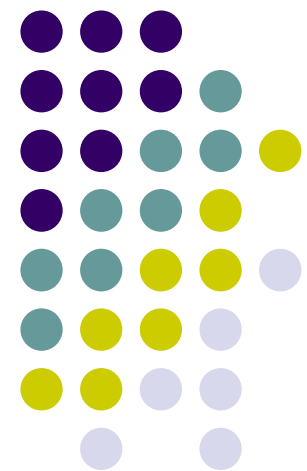# Ubiquitous and Mobile Computing CS 403x: Duet: Exploring Joint Interactions on a SmartPhone and SmartWatch

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Background

- Interactive computing technology is becoming increasingly ubiquitous.
  - palms and pockets, wrist-worn, head-mounted, smart cloth…
- Interaction techniques making use of Interactive computing technology is underexplored

Pervious work

- Handle Devices
  - Touch, tilt, freehand gesture, etc.
  - location
- Wrist-worn devices
  - Touch – fat hand
  - Better motion detection
  - Microphone for fingertip gestures
- Device-to-device interaction
  - Synchrony
  - Proxemic interactions
  - Distributed gesture

About Duet

- Symphony of interaction between multiple smart mobile devices
  - Two smart mobile devices as a joint interactive platform
  - Enables interaction between smartphone and smartwatch, motion and touch input
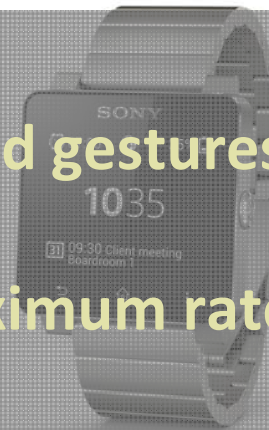
How does it work?

3-axis accelerator

Bluetooth connection

API with 7 pre-defined gestures

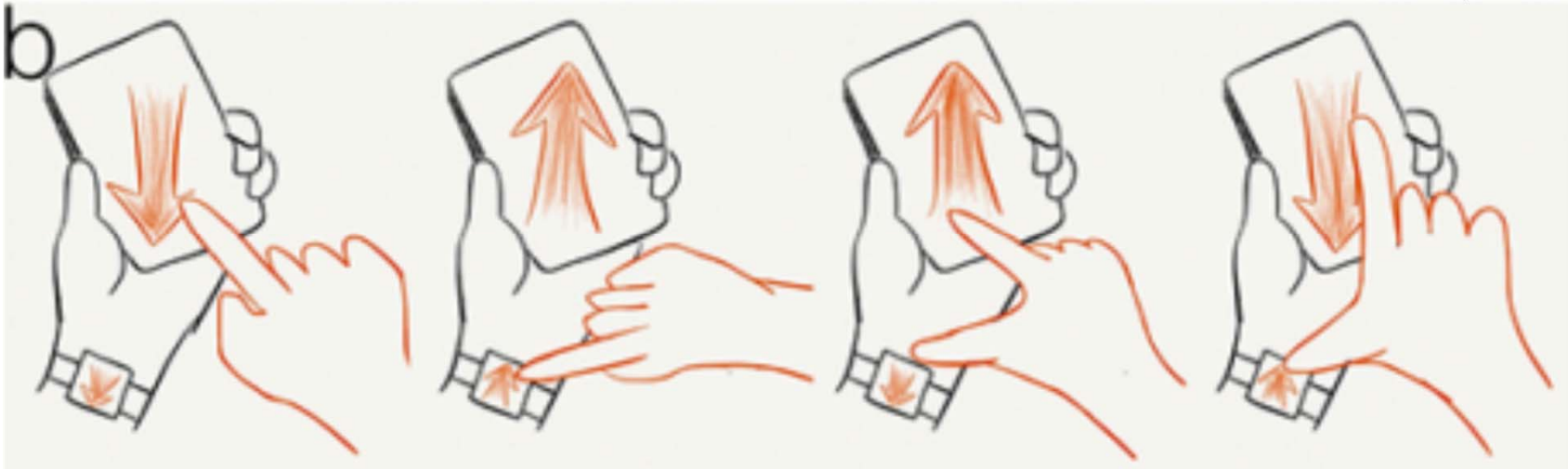**Accelerator with maximum rate of 10Hz**

Dorsal Side
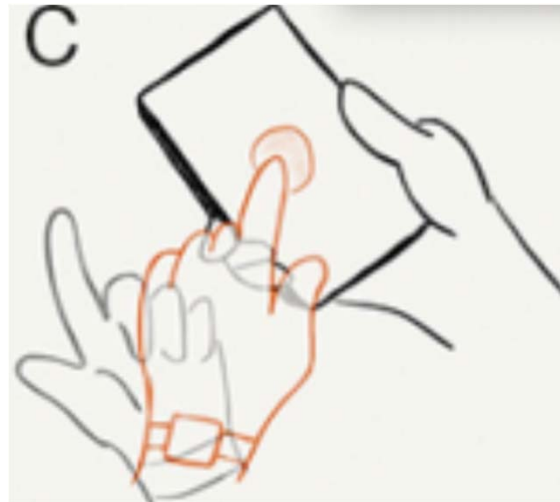
Ventral Side

Gestures
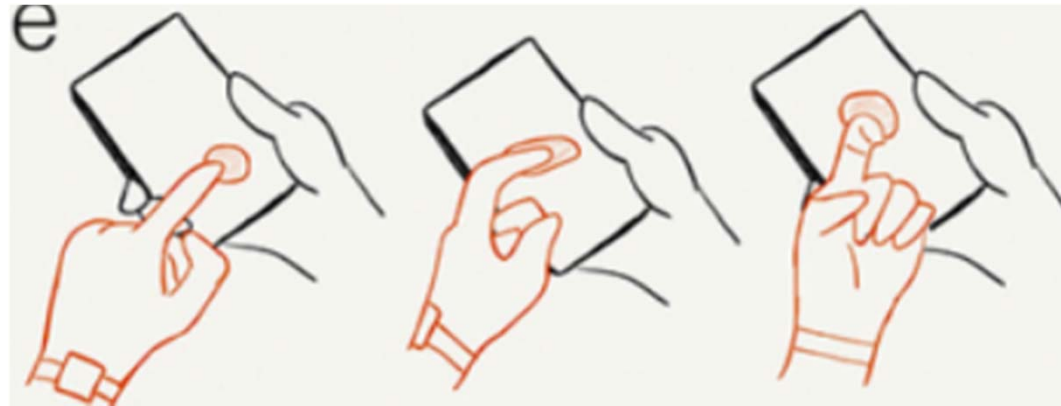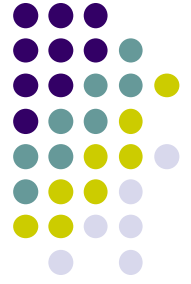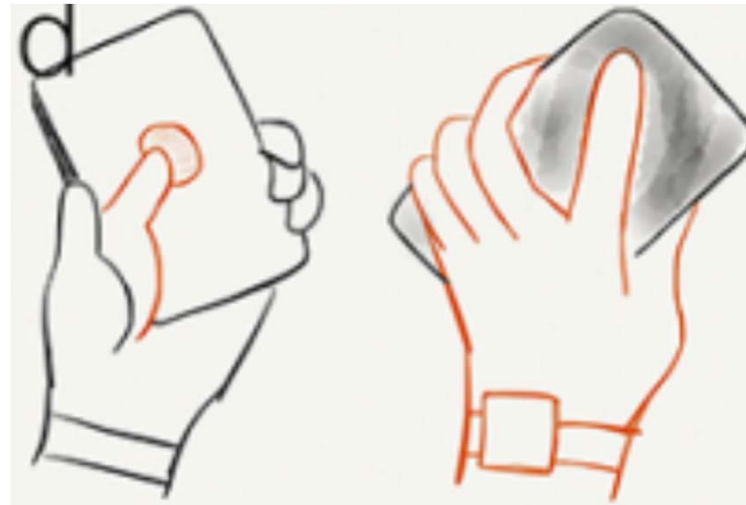

Double Bump

Gestures

Multi-device Gesture

Gestures
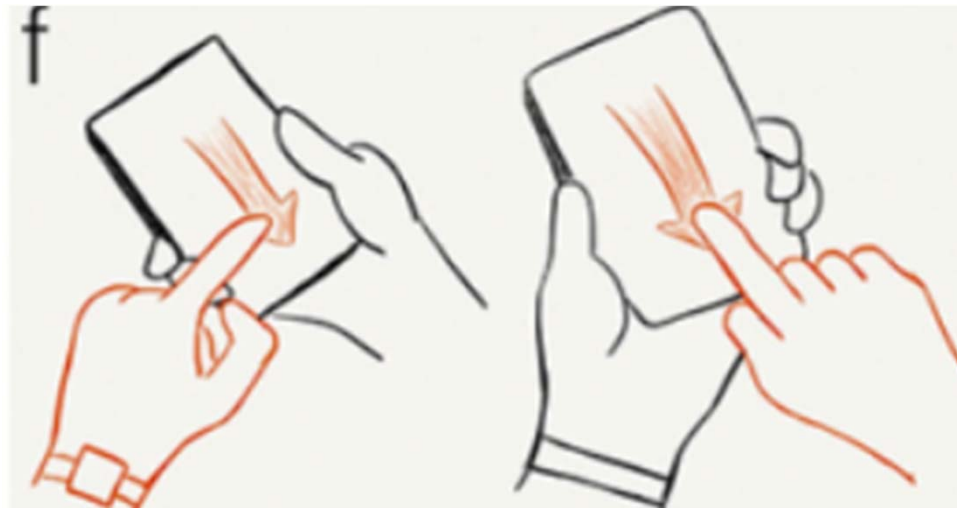

Flip and Tap

Gestures

Finger Gesture Recognition

Gestures

Hold and Flip

Gestures

Handedness Recognition

Accuracy Evaluation

	Double bump	Flip and tap	Hold and flip	Handedness recognition	Finger posture recognition
10-fold cross val.	93.87%	97.90%	97.56%	99.06%	99.34%
Per user classifiers	92.10% (5.34%)	95.92% (2.89%)	90.11% (11.24%)	97.33% (1.92%)	97.95% (0.80%)
General classifiers	88.33% (9.89%)	94.38% (9.91%)	85.29% (10.90%)	98.23% (2.64%)	93.33% (9.07%)

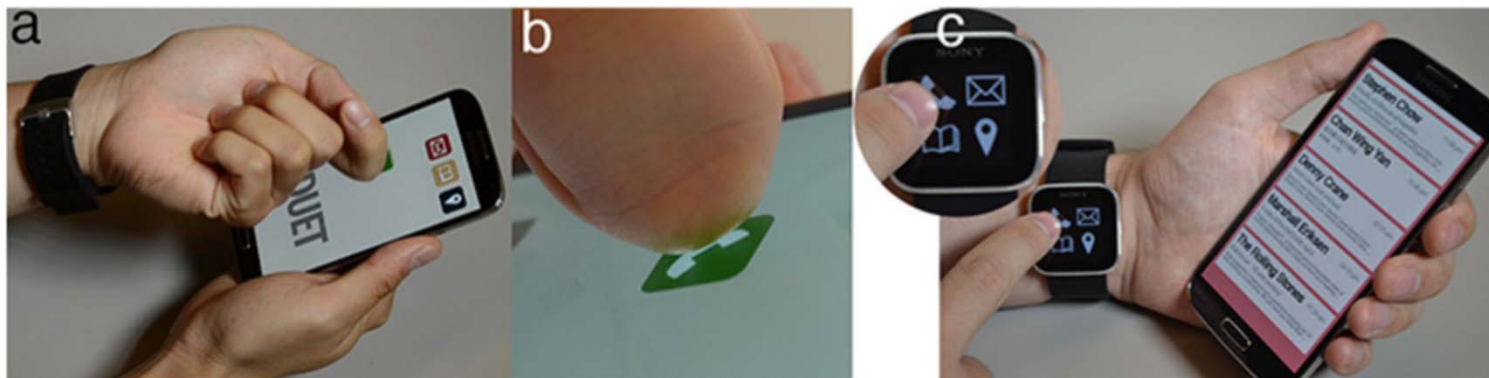| Pinch to open		Pinch to close		Phone to watch		Watch to phone	
97.69% (5.67%)		98.61% (2.32%)		95.83% (3.83%)		96.76% (3.25%)	

Duet - Home Screen

- Hold and flip to unlock

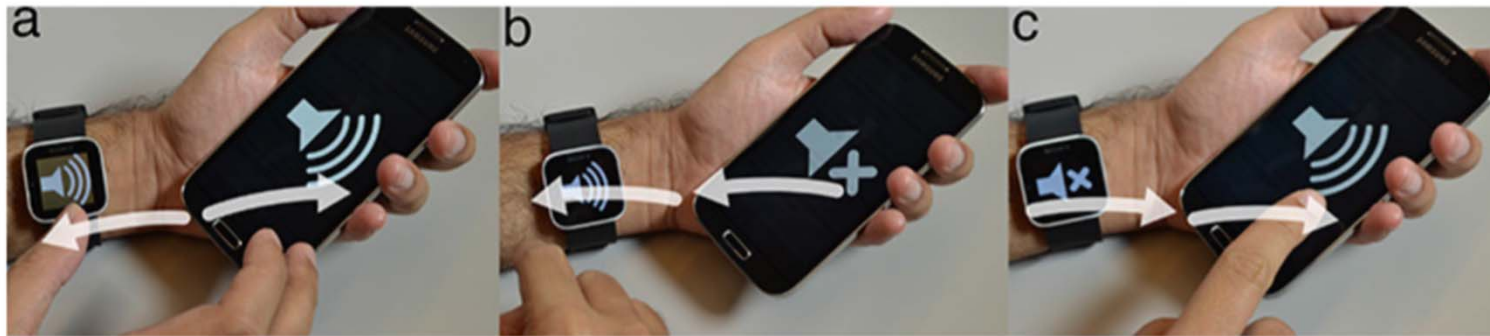

- App arrangement and selection shortcut

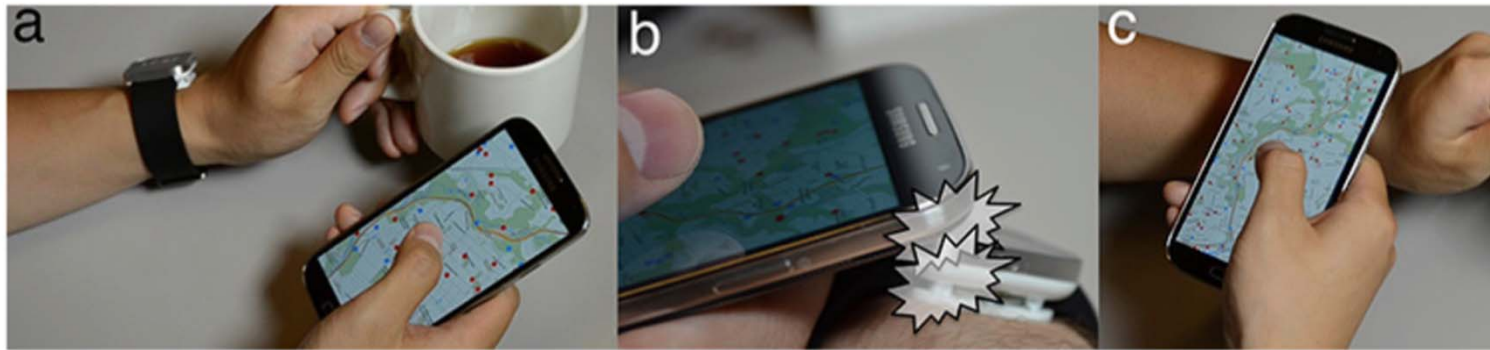# Duet - Email

- List Management

- Notification Management

Figure 6. In Email, Multi-device gestures are used to manage new email notifications on both devices.

Duet - Map

- One Hand Zoom

- Toggle View Mode

Duet - Map

- Multi-Device Target Selection

Duet - Reader

- Menu Access

- Implicit Tool Selection

- Multi-device Clipboard and Tool Palette

Duet - Call

- Information Retrieval

Figure 12. Enabling basic app access on the watch while using making a phone call.

Duet – User Feedback

- 10 Participants
- Demonstrate + Tryout
- Overall positive feedback
  - Lightweight interaction, watch as extended display and auxiliary sensor, devices complement each other
  - No significant improvement, some features cause occlusion
  - Different mapping and fall back

Recognition Techniques

Machine Learning

Decision Tree

Table of features

Multi-device?

References

- ***Duet: Exploring Joint Interactions on a Smart Phone and a Smart Watch*** Xiang 'Anthony' Chen, Tovi Grossman, Daniel J. Wigdor, George Fitzmaurice in Proc CHI 2014