sensing opportunities for mobile health persuasion

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Kairos technology that suggests a behavior at the most opportune moment

-fogg, 2003
two things you need

1. a method to **passively monitor** human activity
2. a method to provide **feedback** about behavior
self-report

- useful for measuring
  - beliefs, feelings, goals
- simple
- low cost

- burdensome
- people are not good at monitoring their own behaviors:
  - eating [champagne, 2002]
  - exercise [lichtman, 1992]
  - routine activities [klasnja, 2008]
  - coughing [liu et al., in submission]
activity inference
a very brief history

want, pers com

1990

instrumenting the environment

bao et al., pervasive

2000

instrumenting the person/clothing

gavrila et al, c. vision

lester et al., ijcai

2010

instrumenting the cell phone

miluzzo et al., sensys

bao et al., pervasive

want, pers com

gavrila et al, c. vision

lester et al., ijcai

miluzzo et al., sensys
not just sensor hardware progressions

- also, advances in machine learning
- ability to store lots of information
- constant connectivity / the cloud
just as location aware computing has ushered in a new era of mobile phone software

so to will activity inference for future mobile phone generations
running

Lester et al., IJCAI 2005
Choudury et al., IEEE Pervasive 2008
walking

lester et al., ijcai 2005
choudury et al., ieee pervasive 2008
transit modes

patterson et al., ubicomp 2003
zheng et al., ubicomp 2008
reddy et al., sensor networks 2009
microphone in ear detects when a person is eating with 99% accuracy

amft et al., ubicomp 2007
cheng et al., pervasive 2010
identifying fluids

instrumented cup

79% classification accuracy

68 different fluids including sodas, juices, beers, wines

lester et al., pervasive health 2010
coughing

liu et al., in submission
automatically detecting coughs with a commodity mobile phone

liu et al., in submission
collecting and analyzing the cough dataset

17 participants
72 hours of naturalistic audio recording
6 graduate students annotated recordings

2542 coughs labeled by annotators

84.4% of coughs were correctly classified
0.7% false positive rate (3.3/hr)

liu et al., in submission
number of coughs

number of coughs measured vs. self-report

self-report

participants

P1 P2 P3 P4 P5 P6 P7 P8 P9 P10 P11 P12 P13 P14 P15 P16 P17

19
number of coughs measured vs. self-report

diff: mean (22.8/hr), std (33/hr)
two things you need

1. a method to passively monitor human activity
2. a method to provide feedback about behavior
zero effort applications for behavior change

goal: minimize interaction costs
approach: passive sensing + passive display

basically, do the activities that you normally do and the mobile phone will automatically respond
two examples:

**ubifit**

encouraging *fitness* behaviors through passive sensing and feedback

*consolvo et al., chi 2008*

*consolvo et al., ubicomp2008*

**ubigreen**

encouraging *proenvironmental* behaviors through passive sensing and feedback

*froehlich et al., chi 2009*
ubi\textit{system components}

\textit{collects} data about physical activities

activity recognition device

\textit{communicates} data about physical activities

glanceable display

phone wallpaper!
ubi system components towards zero effort applications

- activity recognition device
- interactive application
- glanceable display

*collects* data about physical activities
*communicates* data about physical activities
ubifit
personal ambient display

walk
cardio
strength
flexibility
primary goal met
alternate goal met
recent goal met
ubigreen
tracked 6 transit activities

drive alone  walk  bike  train  carpool  bus

“not-green”  “green”

minimum activity duration: 7 minutes
ubigreen
personal ambient display

- current activity
- value icon bar
- evolving image
- phone background (wallpaper)
sense of anticipation for how story would unfold
tree design:

everything resets on Sunday
RESEARCH PARTICIPANTS

Monday

Saturday

ubigreen1

ubigreen2

ubigreen3

ubigreen4

ubigreen5

ubigreen6

ubigreen7

ubigreen8
personal ambient display
impressions of ubifit

If you didn’t have a screen [display], I wouldn’t think about it [physical activity] as much... I think about it maybe subconsciously every time I look at my phone.

- P5_{UF}

With a website, it’s so easy to ignore... it’s just out of sight, out of mind. But on the phone, you can’t really ignore it...  

- P9_{UF}
SUPER MARIO BROS.
©1985 NINTENDO

1 PLAYER GAME
2 PLAYER GAME

TOP- 0000000
game mechanics

- playful
- virtual achievements
- measured progress
- collections
loss aversion
need for quantitative data

I would like to see some graph or raw data.

- P13\textsubscript{UG}

quantitative data
- builds trust system is working
- allows for self-comparison
- some people like it better
effectiveness of the ubifit glanceable display

study occurred over thanksgiving, christmas, and new years.
in conclusion

imagine that you can sense....
running

lester et al., ijcai 2005
choudury et al., ieee pervasive 2008
eating

amft et al., ubicomp 2007
cheng et al., pervasive 2010
lakefront property
lakefront property

phone home/lock screen:
most valuable real estate in all of technology
thank you
@jonfroehlich

thanks to:
sunny consolvo
pedja klasnja
james landay
eric larson
sean liu
shwetak patel
extra slides
sink usage

froehlich et al., ubicomp 2009
larson et al., pervasive & mobile computing 2010
ubigreen sensing transit

1. wearable activity recognition device

2. cell towers

3. user

Drive Alone | Walk | Bike | Train | Carpool | Bus

minimum activity duration: 7 minutes
precursor to ubifit
pedometer cell phone fitness study

Figure 1. a) The Omron HJ-112 pedometer, b) the pedometer in use, and c) the Nokia 6600 mobile phone running Houston.

Figure 2: Houston screen shots. (a) Main screen, (b) detail screen, (c) recent comments, and (d) trending information.

consolvo, et al., chi 2006
ubigreen context-triggered survey

using the myexperience toolkit
Froehlich et al., Mobisys 2007
http://myexperience.sourceforget.net
limitations of sensing

can’t infer thoughts, feelings, intentions
can be expensive
sensing may not yet exist for behavior

froehlich et al., mobisys 2007
http://myexperience.sourceforget.net
personal ambient display
impressions of ubigreen

It’s omnipresent

It definitely keeps you more aware of it [personal transportation]. You use your phone every single day so you know.

- P9_UG

- P6_UG