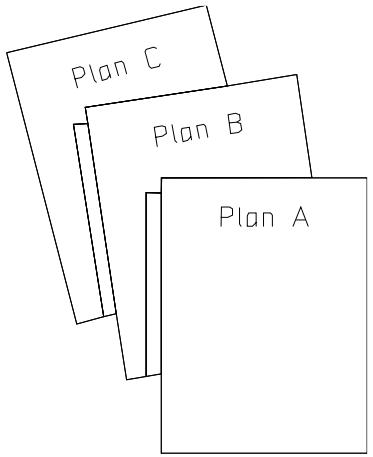
Life-Immersive Mobile Computing

Driving is not about getting the car going in the right direction.
Driving is about constantly paying attention, making a little correction this way, a little correction that way.

Overview

- Objective
  - To discuss various examples of life-immersive mobile applications
  - To come up with a novel project idea



- Content
  - Life-immersive mobile applications and systems

- After this module, you should be able to
  - Understand the uniqueness of mobile applications
  - Understand the state-of-the art examples of life-immersive mobile applications
  - Find seed ideas for a strong course project

Instructor

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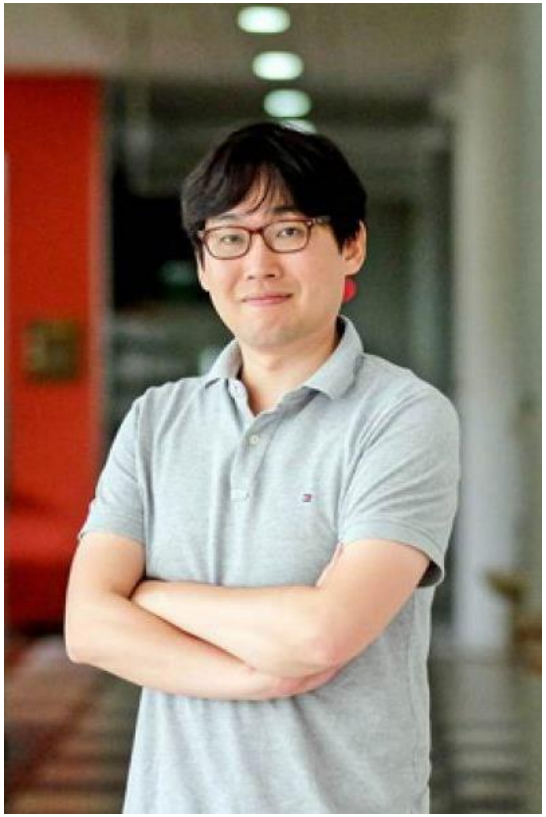
- Research Homepage: http://youngkilee.blogspot.com



Tentative Lesson Plan

Week	Lecture Topic	Project Deadlines
1	Class Intro & Intro-to Mobile Computing	
2	Human Behavior and Context Sensing/Analytics: Activities	
3	Human Behavior and Context Sensing/Analytics: Activities	
4	Project Proposal and Feedback	March 25 Monday [11:59pm]. Push the final proposal slides (in git repo)
5	Human Behavior and Context Sensing/Analytics: Locations	
6	Human Behavior and Context Sensing/Analytics: Locations	
7	Human Behavior and Context Sensing/Analytics: Emotions and Health	
8	Human Behavior and Context Sensing/Analytics: Emotions and Health	
9	Special Topics	
10	Project Review and Demonstration of Initial Prototype	May 6 Monday [11:59pm]. Push the review slides and apk for the demo prototype (in git repo)
11	Mobile and Embedded Machine Learning Systems: Basics	
12	Mobile and Embedded Machine Learning Systems: Power and Optimization	
13	Mobile and Embedded Machine Learning: Cloud and Edge	
14	Mobile and Embedded Machine Learning: Privacy and Other Issues	
15	Project Final Presentation and Demo	June 10 Monday [11:59pm]. Hard deadline. code, final apk, final presentation slides in git.
15/16	Final Exam	TBD

Project Teams

- Please freely come up with teams of 3 (or 4).
  - Sign up for the team at: http://goo.gl/xybUo3 .
  - Let me know if you need help.

- You can change your team by the end of this week.
  - Make sure to update the above spreadsheet when there is a change.

- Switching of teams are not allowed from Week 2 onwards.

Paper Presentation

- Reading list is available at: https://goo.gl/cdqR89
- Pick the paper you want to present and sign up here: https://goo.gl/QegLWv
- First come first served.
- We will improve on reading and presenting papers along the way, but you can start with the following paper.
  - How to Read a Paper, S. Keshav
    [ACM SIGCOMM Computer Communication Review, ’07]

Mobile Computing

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Life-Immersive Computing

Tightly integrated with **real-world** situations

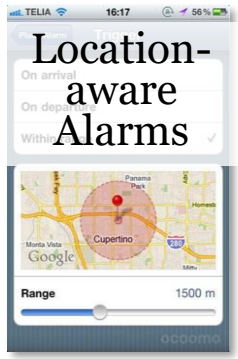
Continuously monitor **ourselves** and our **real-world** situations

Provide what we need **right on time & place**

Sleep Quality Monitoring

Physical Activity Diary

Pothole Monitoring



Location-aware Alarms

Bus Stop Queue Estimation

Smart Vibration

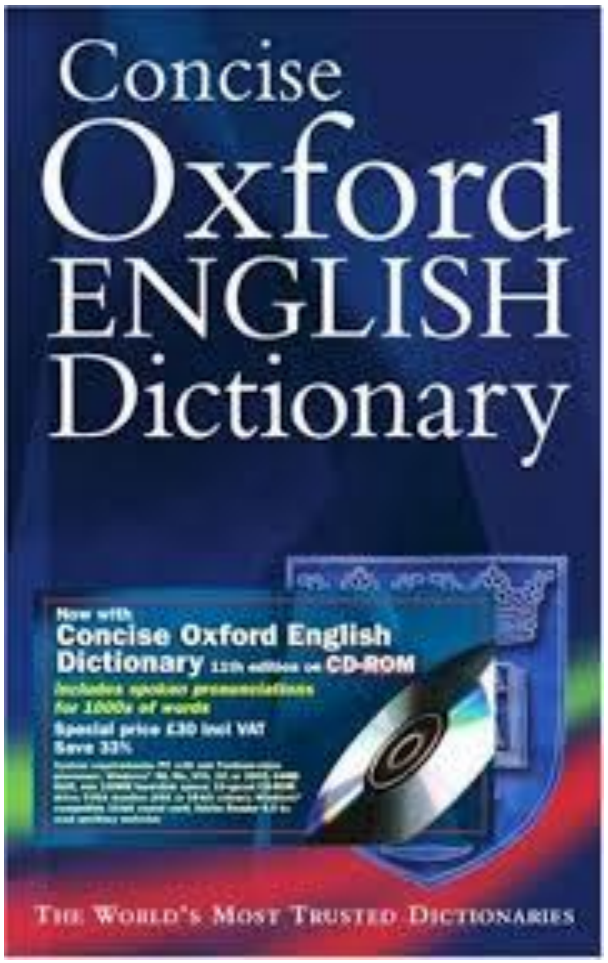
Auto-Silencing My Phone

Proactive Advertisement

We should go beyond

- Making existing applications mobile-specific
  - Mobile-tailored UI to be suitable to a small screen and touch-based interfaces
  - Less resource consumption
    - Many devices still do not have GPU
    - CPU has also less cores with lower operating frequency
  - Less battery consumption

Example: Dictionary



Example: Dictionary

Example: Dictionary


Concise
Oxford
ENGLISH
Dictionary
Concise Oxford English Dictionary
THE WORLD'S MOST TRUSTED DICTIONARIES
Dictionary (English <> Spanish) + Translation (English > Spanish) + Auto-detect(52) > Spanish
community
Latvian
Lithuanian
Macedonian
Malay
Maltese
Norwegian
Persian
Polish
Portuguese
Romanian
Russian
Serbian
Slovak
Slovenian
Dictionary
community [kəˈmju:nətɪ] [US]
noun
1. común
2. comunidad
3. sociedad
4. colectividad
5. unión
6. mancomunidad
Close
Lock
Auto-Hide
Options
Web Site
quick
quick
done, happening, or moving fast; lasting only a short time
She cast a quick glance in the mirror.
You're back already -- that was quick!
He made a quick profit.
John was quick to point out the error.
SMART thesaurus
Fast and rapid
See also:
Short in time
We bought it quick, before someone
WHAT'S
NEXT


07:10
GALAXY
Note II

Dialogue-Immersive Dictionary

1. Listens to on-going dialogue
2. Spots words or expressions which a user may not be familiar with
3. Searches a dictionary in the background
4. Whispers the searched word to the user's ear

- Harmony with the flow of the on-going dialogue
  - Non-obtrusive, immersive to the dialogue for smooth continuation
- Contextual selection
  - Understand the contexts of the on-going dialogue, and select (or order) the best-matching meaning,

  E.g., spring: (1) a season, (2) spiral of wire, (3) violin sonata

TV Show

Video On Demand

VOD on Mobile

How do we make it better?

How do we coming up with Innovative mobile services?

- Not an easy question! There is no single answer for this.

Seed for Project Ideas

- Who do we want to help with?
  - Children
  - Elderly
  - University students
  - Shoppers
  - People in developing countries
- What are the situations where they face difficulties?
  - Children (with developmental delays playing at home)
  - Elderly (living alone having medical issues)
  - University students (having severe stress or depression)
  - Shoppers (looking for a place to rest and eat)
  - People in developing countries (whose village flood often)
- How do we design and develop services using the state-of-the-art mobile (and of course other) technologies?

Parents of Children with Language Delays:

Conducting home language therapy

Communication Developmental Delay

Problems of **early communication delay** can **compound in adulthood**!

Communication Delay → Reading/ Writing Disorder → … → Psychiatric Disorders → Low Socioeconomic Status

Childhood

How to Help Better Communicate?

Today's Practice

- Help from 'human experts'
- 1~2 sessions per week/ occasional
- Expensive

Mobile/IoT/Wearable Technology?

- Help with mobile services?
- In-situ intervention
- Daily, inexpensive solution

Proposed Solution: TalkBetter

Inter-Personal Interaction Agent

- Conversation/interaction is an integral part of our life.
- There often are communication problems for different relationships.
  - Parent / child (teenager)
  - Couples
  - Advisor / Student
  - Colleagues
  - Presenters
- Can we build a technology to understand various aspects of on-going human conversation? Can we design a service to help people communicate better in various situations?

Theory of Cockpit Culture*

*From Malcomm Gladwell's Outlier

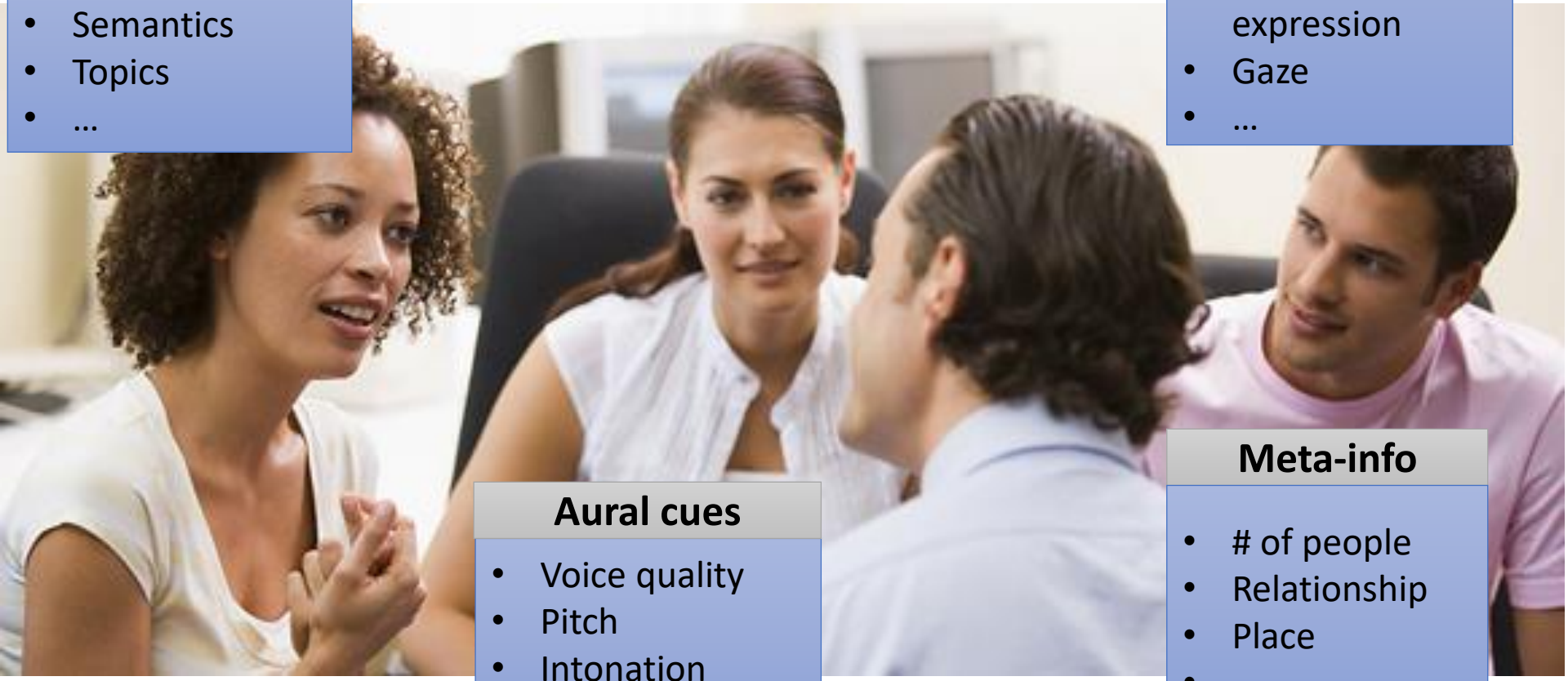
What to Capture?
Components of Interaction

Verbal cues

- Spoken words
- Semantics
- Topics
- …

Visual cues

- Hand gesture
- Body posture
- Facial expression
- Gaze
- …



Aural cues

- Voice quality
- Pitch
- Intonation
- …

Meta-info

- # of people
- Relationship
- Place
- …

Exercisers:

Running on a treadmill


50%
of exercisers drop out
within 6 months
Wilson & Brookfield, 2009

Reasons for Exercise drop out

Lack of

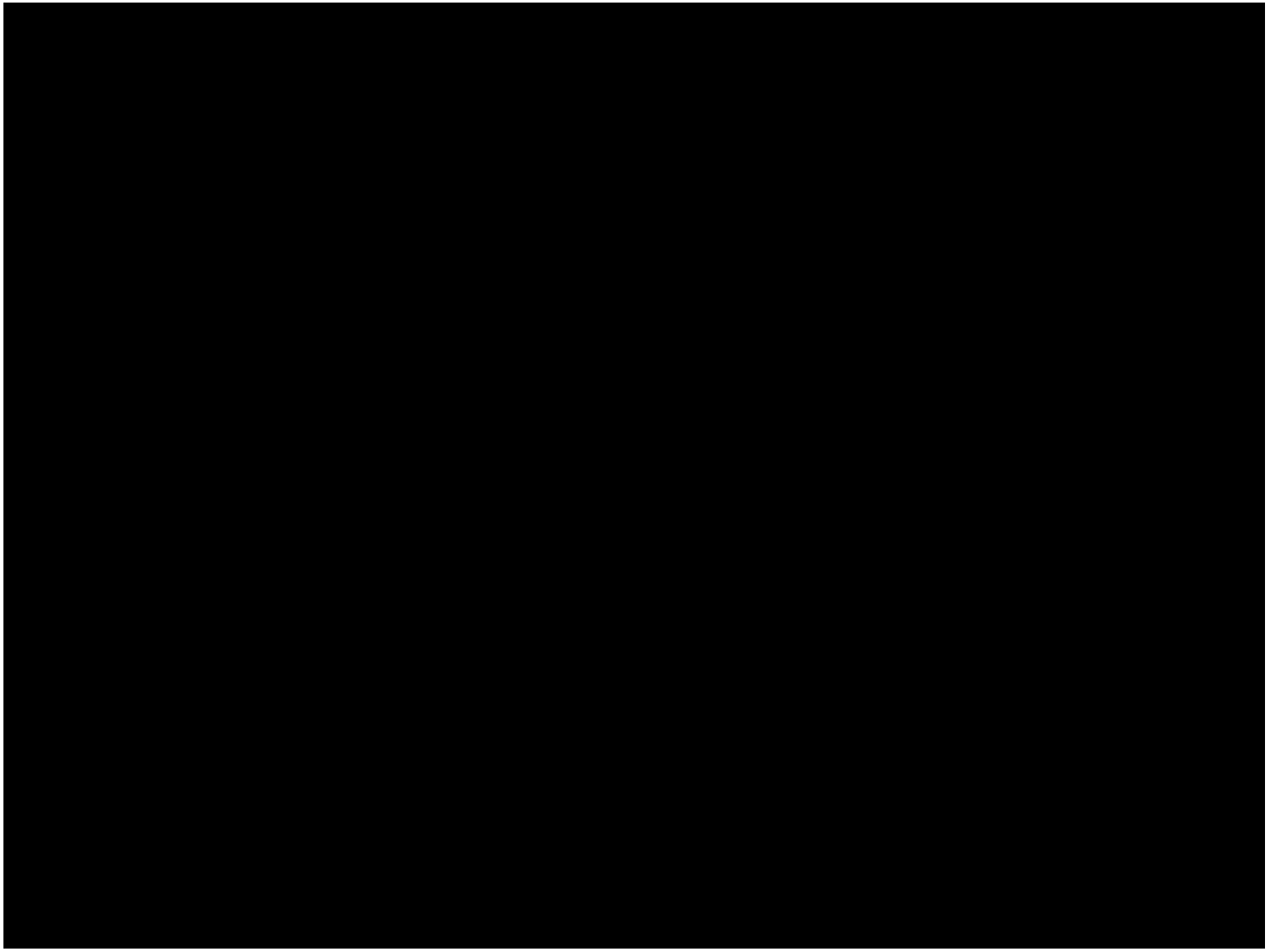
- Motivation
- Poor body image
- Expense & Time

Len Kravitz
University of New Mexico

Monotonic,
Repetitive,
Isolated

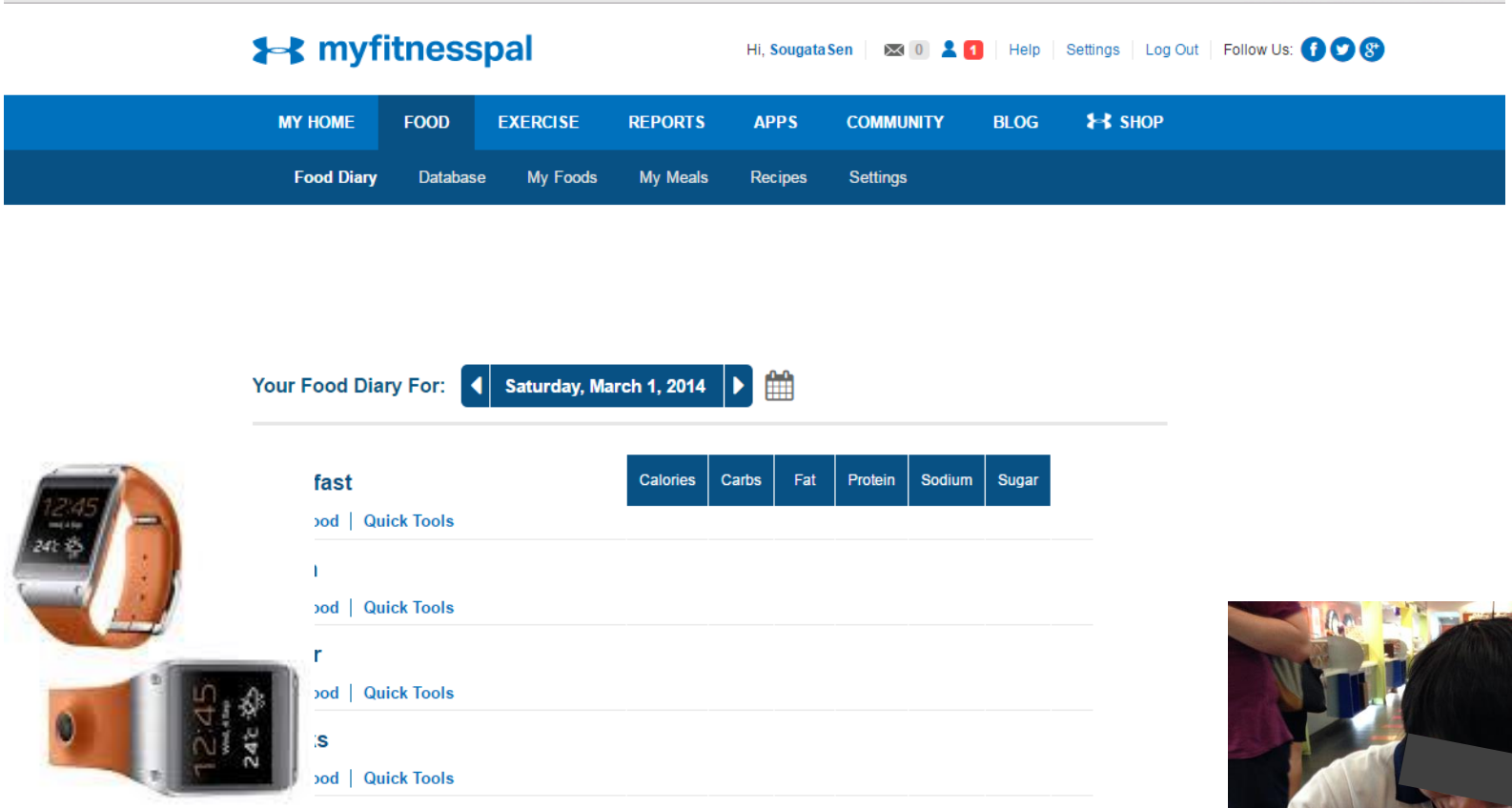
Ideal forms of exercises

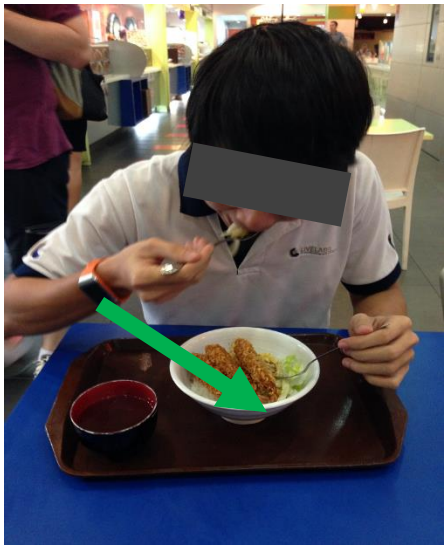
Proposed Solution: SwanBoat



People with Obesity:
Monitoring their Diet

Smartwatch-based Eating Tracker





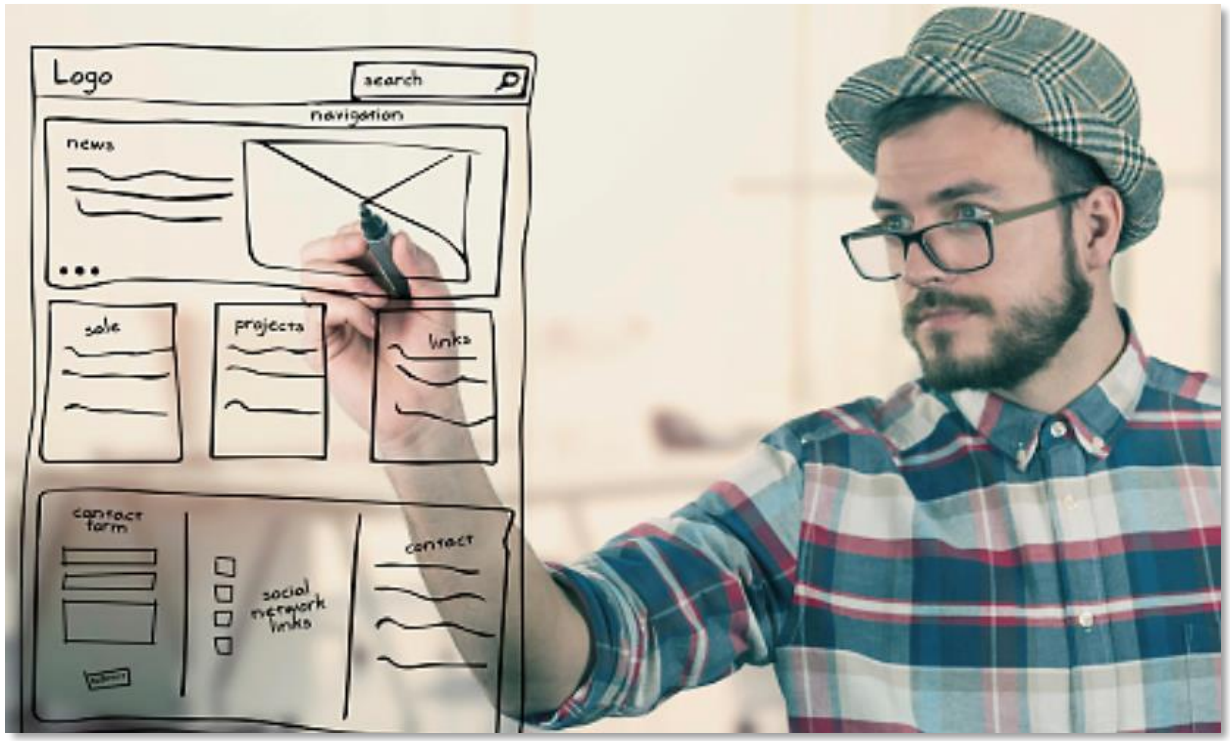
Gesture Recognition : accel + gyro
Image Capturing : camera

Activity and Behavior Monitoring

- It will be of good use to monitoring human activities and behavior, and provide appropriate feedback

- There are various activities people would like to quantify and objectively understand.
  - Walking / Running / Sitting / Posture
  - Gym Workout
  - Eating
  - Commute
  - Conversation

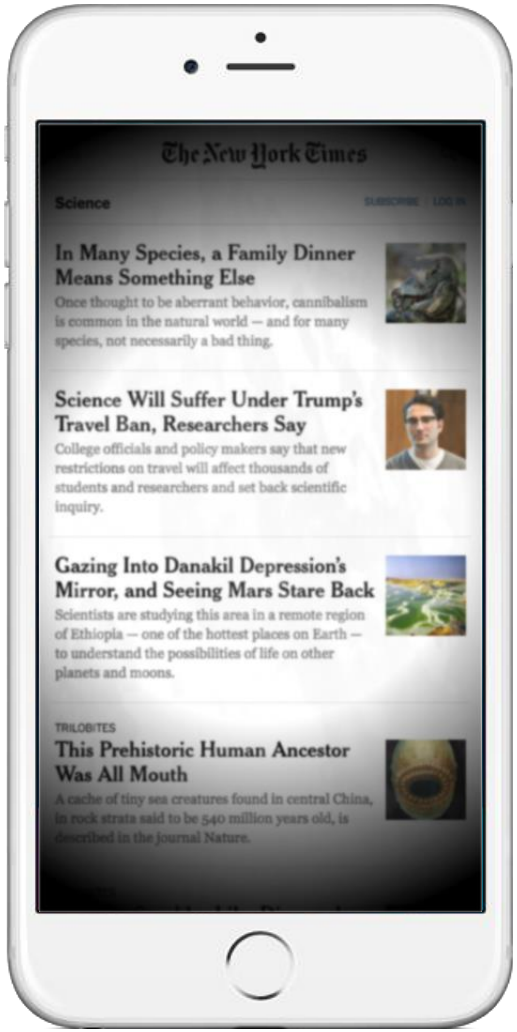
- What types of behavior / activities do people want to understand? How can we build technology to monitor them in an accurate and resource-efficient way? How should we design a service to change people's behavior in a healthier way?



Mobile Developer:

Designing a news reader for the elderly with glaucoma

Read the news.



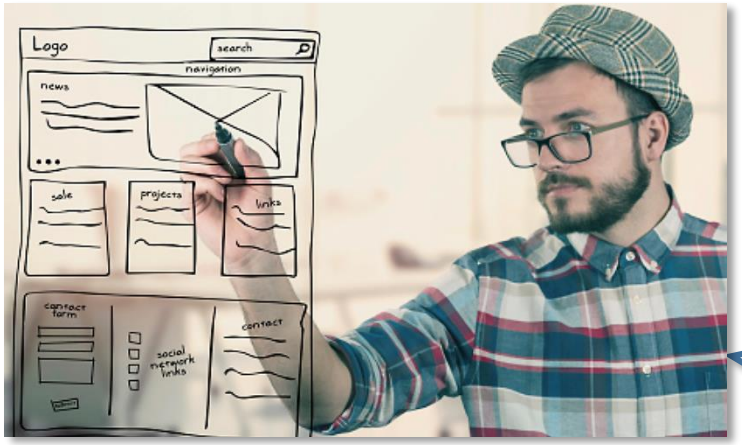
You're 60 years old.

You have mild
cataracts *and* **glaucoma**

Many of us will eventually face this problem!

Designing mobile apps to be inclusive is hard!

Typical
designer-developer ?



- avg. 33 years
- 44% time spent on **design** and **testing**

Young, healthy
hard to empathize
with impaired users

InMobi. (2016). *State of Mobile App Developers*.

Designing mobile apps to be inclusive is hard!

Typical
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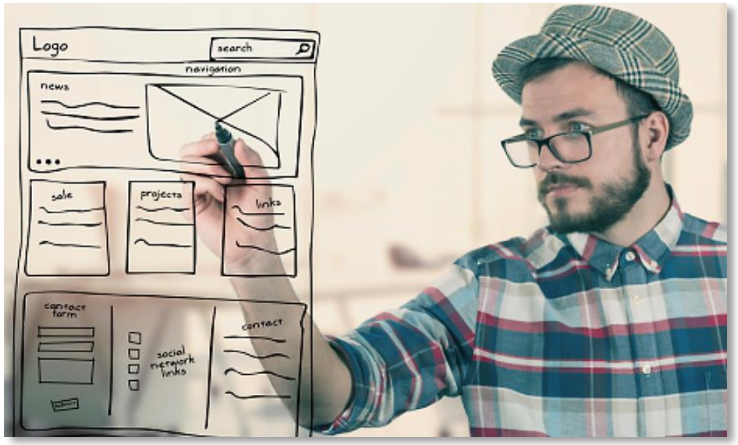
????



Poor support for design

Text size

Many older people require large text due to declining vision, including text in form fields and other controls.

WCAG 2.0 success criteria:

- 1.4.4 - Resize text (AA) says "text can be resized without assistive technology up to 200 percent without loss of content or functionality"

Web Content Accessibility Guidelines 2.0

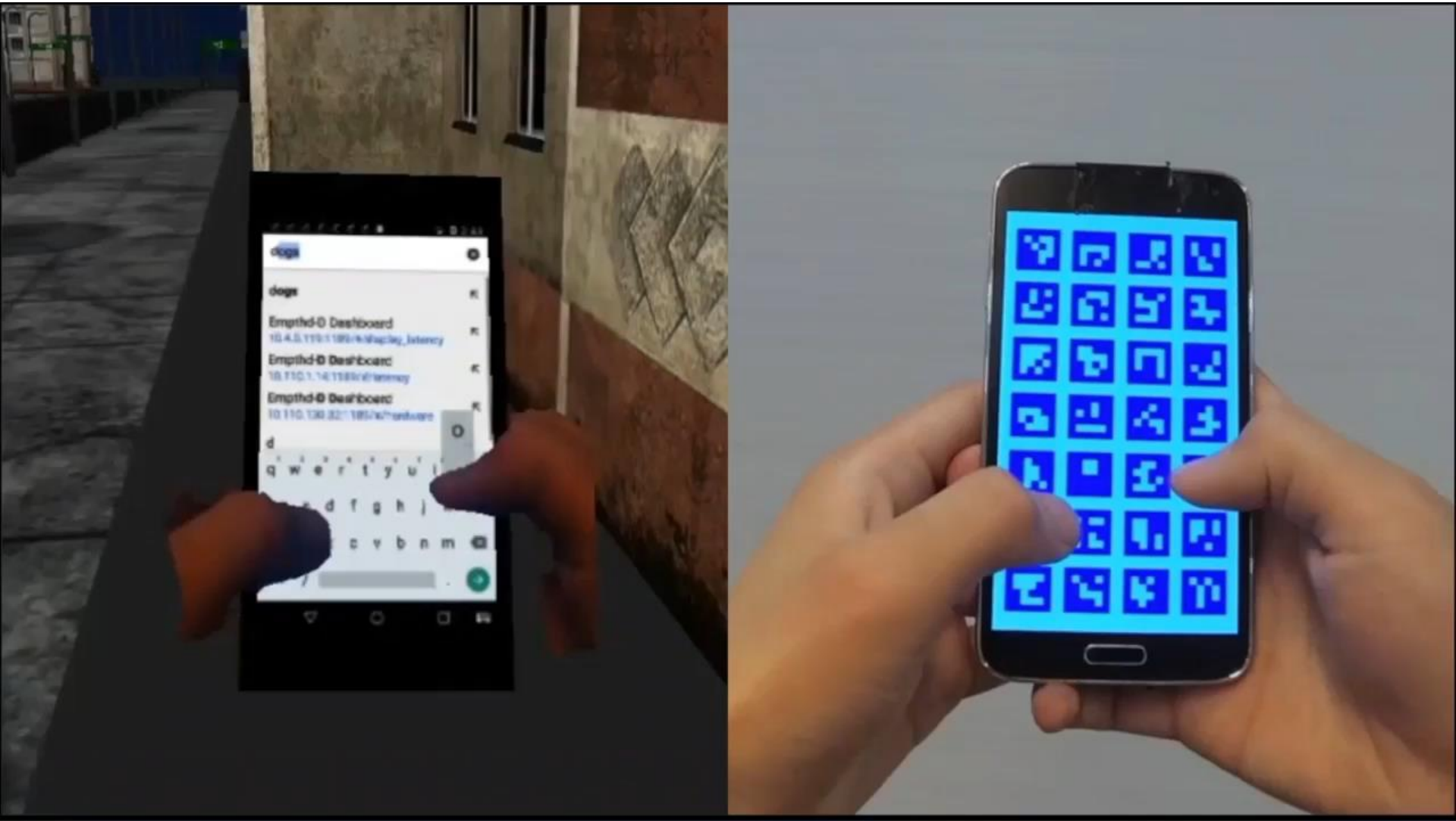
Is this sufficient for cataracts?

Prototype Impairment Simulator

Camera-See-Through mode
for Augmented Reality

Cataracts Impaired View
Of a Web Page

Proposed Solution: Empath-D



Tools for Mobile Developers

- Developing mobile applications and systems are quite different from existing ones.

- How can we build the right tools to help developers to build good mobile systems / applications?
  - Power monitor
    - At a function level
    - Under different situations
  - Taint tracker
    - Make sure your app only access / send the information with right permission
  - UI tester
    - Make sure the usability of your application is intuitive

Shoppers:

Looking for place to eat

Location-aware Promotion

- Group-aware promotion to satisfy the entire group.

Mobile Advertisement

- Contextual mobile advertisements are becoming more important not only to meet customer needs but also to increase company revenue.

- How can we make the advertisement / recommendation better targeted?
  - Use of location?
  - Use of group?
  - Use of attention level?
  - Use of prior visit patterns?
  - Use of your friends' recommendations?

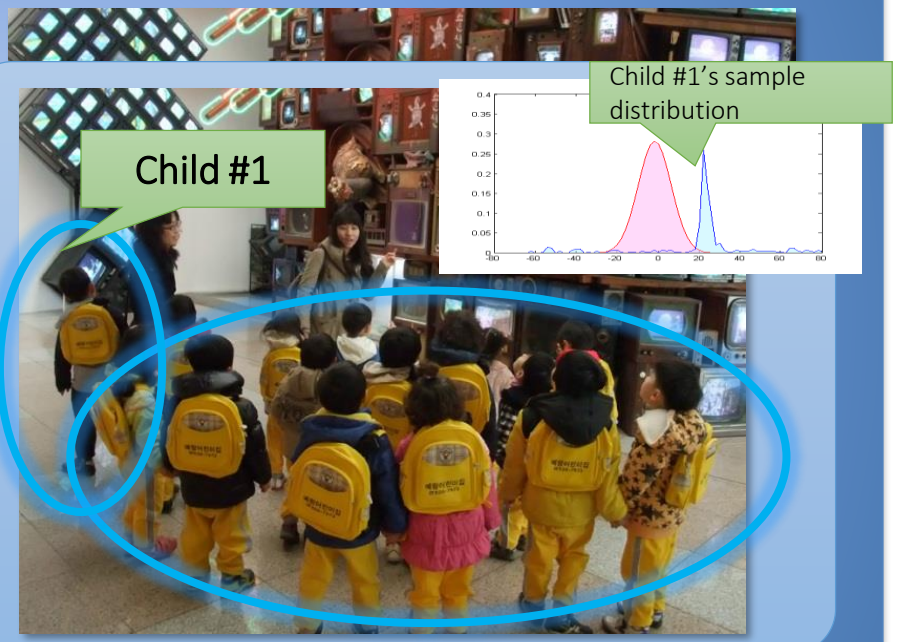
Kindergarten Teachers:

Finding children's talent

Kindergarten Fieldtrip Assistant

"A picture is worth a thousand words"
"百聞不如一見"

Group Behavior Observation



Mobile Services for Education

- Education plays a significant role in people's life.
- There are lots of initiatives to use technology to improve the quality of education.
- What will be such possibilities?
  - Attention monitoring for online education tools
  - Automated QnA system for online education tools
  - Boredom sensing and feedback to lecturers

Life-Immersive Mobile Applications

- **Proactive** and **situation-aware** services!

Make the invisible visible to human.

- Detect daily exposure to dust or UV light
- Detect food consumption and estimate daily caloric expenditure

Lighten cognitive loads and human efforts.

- Support teachers and parents who care children with developmental delays
- Support social caregivers to provide timely help to the elderly

Enrich interaction with physical world.

- Send group-aware promotions when users have free attentive capacity
- Detect movement of rodents to prevent epidemics

Bring fun, improve wellness, and many more.

- Enable fun gaming during boring life activities such as commuting or exercising

Team Exercise : Cool Project Ideas

- Create powerpoint slides with the following
  - Who do you want to help?
  - What problems are they facing?
  - What are the currently available solutions (does not have to be technology-driven)?
  - Any initial solution ideas? How is your solution different from existing ones? How does it solve the pain points of the target users?
  - Is it feasible to implement? What are the expected deliverable? What are the expected challenges?