Stretching IoT toward (understanding) Human Relations and Interactions

Youngki Lee, Inseok Hwang, Younghyun Ju,
Chungkuk Yoo, Chulhong Min, **Junehwa Song**, and MANY OTHERS

SMU (Singapore Management Univ.)
IBM Research Austin, USA
Naver Labs.
KAIST (Korea Advanced Institute of Science & Technology)

MobiSys 2013, CSCW 2014, UbiComp 2015, etc

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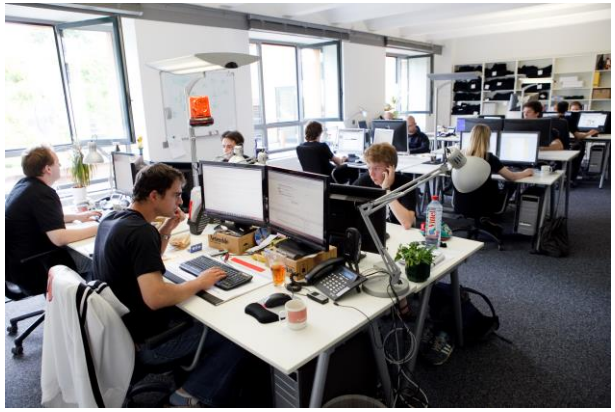
the 1st generation | the 2nd generation | the 3rd generation



Internet of Things

laboratories
scientists & engineers
complex science computation

on top of DESKS
office workers, students
desk tasks (pen-and-paper)

on every THING
everybody
???

What do we do with it?

An early story:

Or Nike+iPod?

cf) iRiver Story

Different?

- An early story!

- How is it different from traditional
  - computing?
  - networking?

- About real world and real life!
- More about people and their lives in real-life situations!
- More about design, specifically service design!
- Come and go quickly!

Computing for REAL-LIFE Situations

- Users and their experiences in real-life situations
  - Understanding users and their life situations
  - Design from user experiences toward systems and technology

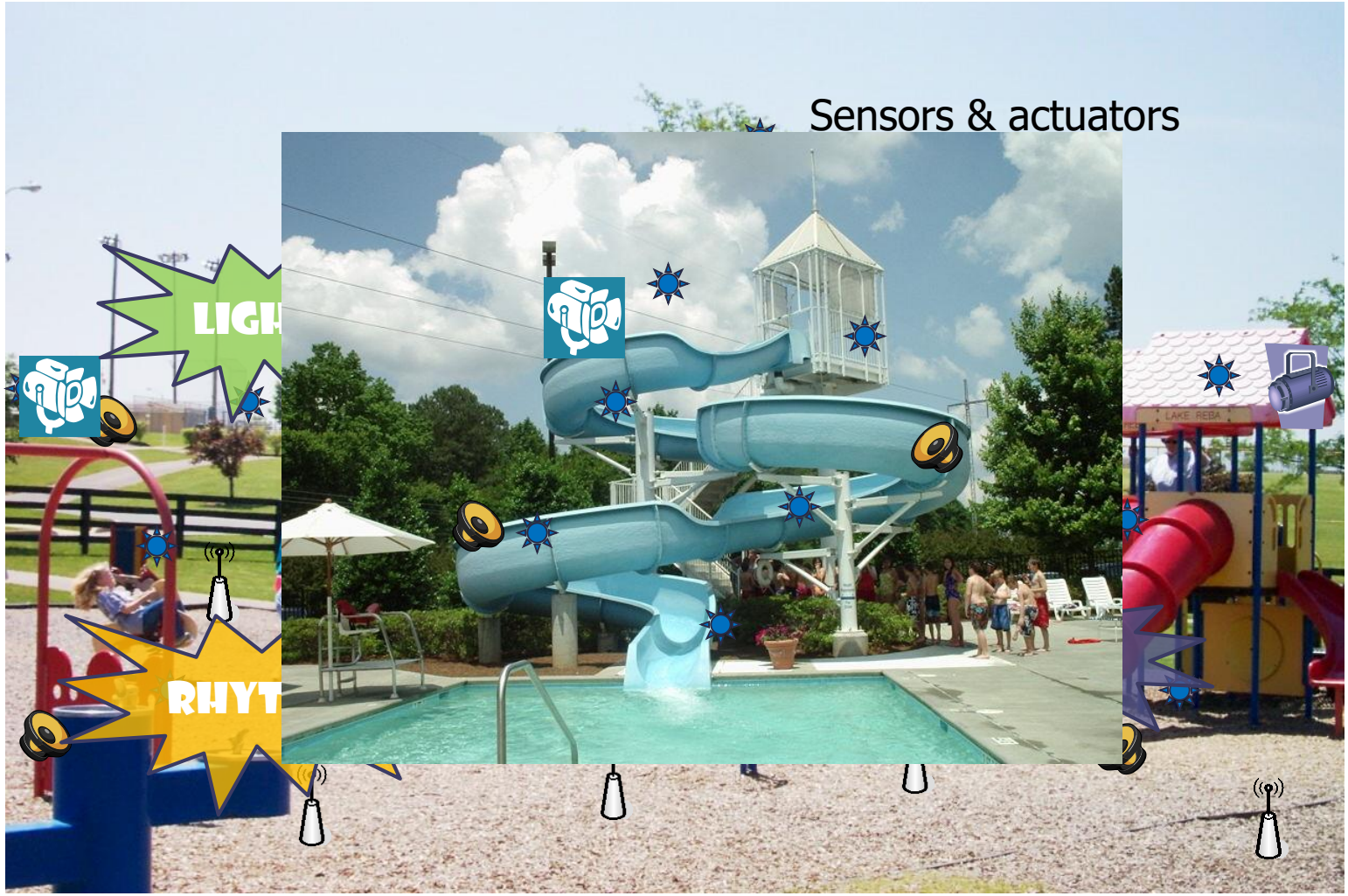
- EXPERIENCE design .vs. a well-defined LOGIC design
  - Users are under very specific real-life situations; they are
    - playing soccer in the playground,
    - dancing in a night-club,
    - brushing teeth,
    - …ing in xxxx at ooo with …, etc …
    - and *are not in front of computers at all* !!!

Computing for REAL-LIFE Situations

- Situation is real, i.e., highly COMPLEX, highly DYNAMIC
  - Far beyond what can be predicted
    - Actions, responses, mood, …
    - Wonders, surprises,
      - Kids climb up the slide in a playground
  - Beyond interior, space, machinery design
    - Deal with flows of actions, situations, experiences, …

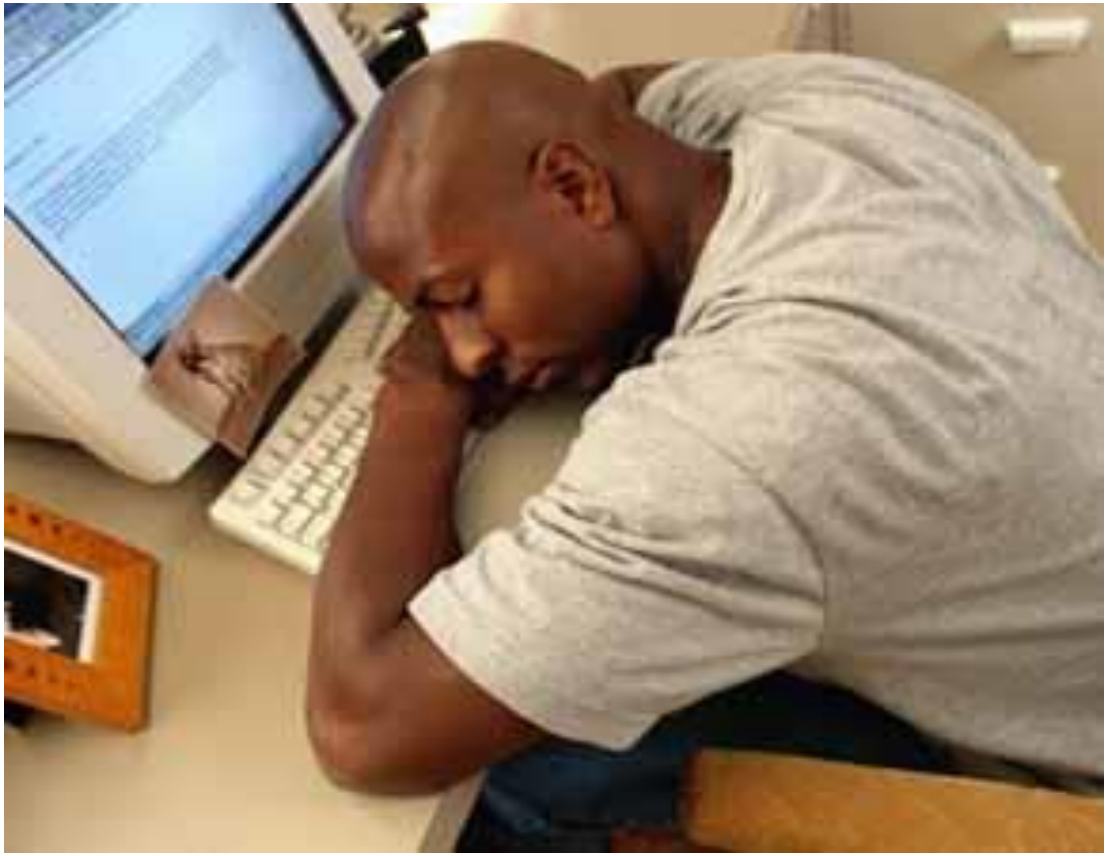
- Roles go beyond mediating computers and users
  - Fall into and feel users, and their situations
  - Enrich experiences; support and guide *emotional* and physical interactions

PLAYGROUND: enrich children's experience?

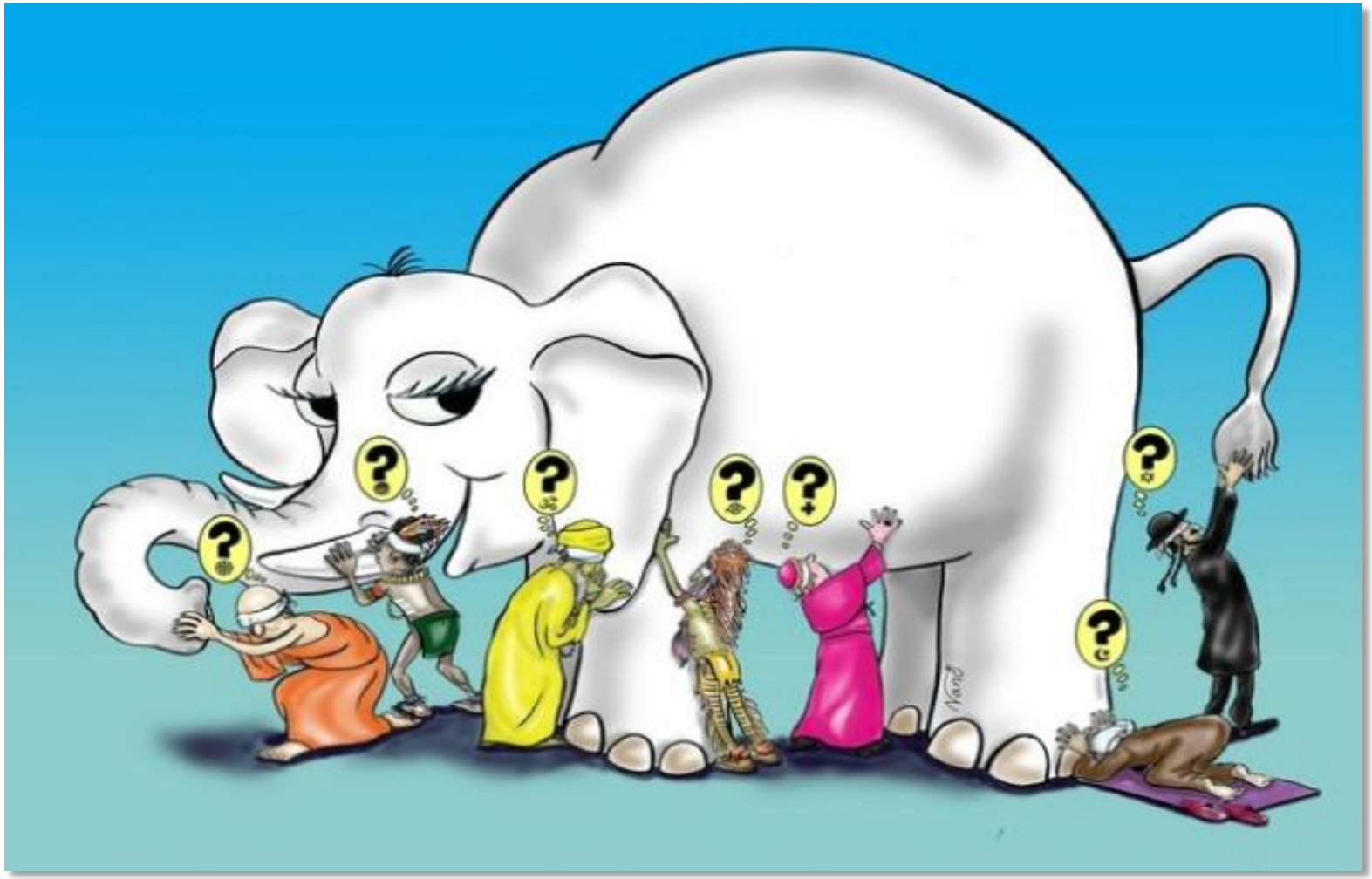



AVING news network


2010
SOUTH
KOREA



Challenge: Awareness on REAL-WORLD and LIVES



Toward Life-Immersive Computing

- Preliminary stage
  - Re-produce PC apps; 'just-a-moment' (잠깐만)!
    - MP3, AnyPang, AngryBird, Twitter, KaKaoTalk, …
  - Re-active

- The first round (of my research)
  - Experiments on the potential of life-immersive computing
    - Simple awareness on people and their surroundings
      - running, walking, sleeping, studying, talking, playing, hand-waving, physiological …
      - Exercising: treadmill-running, jump-roping, hula-hooping, swimming
      - Kids: kindergarten, kid's excursion to museums
      - Young people in a networking party, …
  - A **PLATFORM** of a **NEW CONCEPT**, supporting simple life-immersive-ness with context monitoring

Toward Life-Immersive Computing

- The second round
  - Awareness on (and support for) human interactions
    - **Parent-child** interactions
      - Children with language development delay, parent-child conflict management
    - … … **workplace relations**, …

Human, Relations, and **Interactions**

Being a GOOD Parent, a GOOD Colleague

Being a good parents

- (Gordon, T., "Parent effectiveness training: the proven program for raising responsible children," Random House LLC, 2008,)

There are millions of new parents each year. They face the most difficult tasks and responsibilities.. They take full responsibilities for the babies who cannot do anything, … … raise them to live in the complex world….

Are these new parents prepared for the tasks? … …. The question is how they resolve the conflicts and clash of desires … … they have never been trained and educated … most of them act in the same way that their own parents, or grandparents, grand-grandparents, … did for hundreds of years…. Some have been used for probably 2000 years. …… It is not because there have not been discovery of new knowledge … the opposite. … psychology, child development theories, and other behavioral sciences … which help parents and children, … , methodologies to support others' development, psychologically healthy environments, …, effective human relations, power relations, conflict resolution, … parents have been open to new knowledge and wisdom … understand and learn new technologies …

TalkBetter

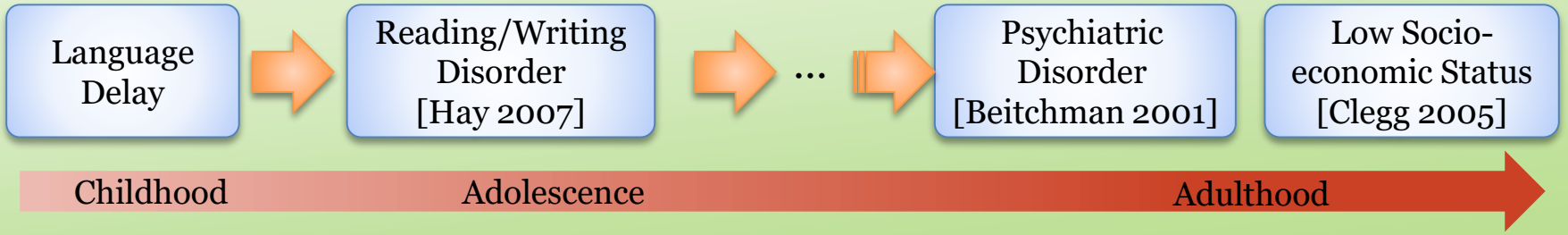
Family-driven Mobile Intervention Care for Children with Language Development Delay

LANGUAGE DEVELOPMENT DELAY

A common concern of many new parents

7.4% in U.S. kindergarten children [Tomblin 97]

Early language delay: problems get amplified over time!



Hay, I., et al. , Language Delays, Reading Delays, and Learning Difficulties: Interactive Elements Requiring Multidimensional Programming. *Learning Disabilities*, 2007.

Beitchman, J. H. et al. Fourteen-year Follow-up of Speech/Language-impaired and Control Children: Psychiatric Outcome. *American Academy of Child and Adolescent Psychiatry*, 2001.

Clegg, J. et al. , Developmental Language Disorders: a Follow-up in Later Adult Life. Cognitive, Language, Psychosocial Outcomes. *Child Psychology and Psychiatry*, 2005

Tomblin, J. B. et al. , Prevalence of Specific Language Impairment in Kindergarten Children. *J. Speech, Language, and Hearing Research*, 1997

Language Development Delay

- Research on Speech-language pathology (SLP)
  - early treatment, important
    - 40% of two-year-old children with language delay developed into those with persistent language difficulties by the age of four [Dale, P. S., et. al, 2003]
  - **parent participation on daily lives, important** [Girolametto 86][Manolson 92][Manolson 09][Pennington 09][Romski 11]
  - parent training and prescription by SLP experts [Manolson 92]
    - e.g., **"Observe, Wait, and Listen" (OWL), "Waiting enough for the child to respond" , "letting the child lead the dialogue", "Promoting turn-taking to continue the dialogue"**
    - introduced in 70's, and gathering attention recently [Pennington 09]
- Interview with experienced SLP experts
  - **parents'** participation during daily lives, absolutely important
    - **24X7 interactions** with parents / expert's treatment is limited in environments and time, usually 1~2 times/ week, effects do not last
  - negative perception in Korean culture: lose chances of early treatment, worsen situations

Language Delay Treatment

Formal

Special situation
Limited coverage
in time, place, and relationships

Common Practices:

- 30~60 min per session
- 1~2 sessions per week
- Takes 1~3+ years
- Role-played situations

Why not Everyday?

Unique Benefits:

- Vast spatial+temporal coverage
- Real situations
- Real people

Today's Practice: Parent Training

Parents are the best partner, but not always helpful
Slow comprehension, limited vocabulary, unwilling to talk, ….

"Make more turn-takings with the child."

"Respond immediately when the child talks first."

"Set a topic that the child is interested in."

"Praise the child."

"Articulate what you speak."

"Wait for the child to talk back."

"Talk more slowly."

"Use positive words."

"Do not interrupt the child before she completes what she says."

"Talk in short sentences."

"Repeat the important keyword."

"Make eye-contact with the child."

"Spend more time talking with the child."

"Refrain from making one-sided instructions."

Clinical outcomes report:

- Manolson, H. A. It Takes Two to Talk: A Parent's Guide to Helping Children Communicate. *Hanen Centre Publication*, 1992.
- Pennington, L. et al. Effects of It Takes Two to Talk – The Hanen Program for Parents of Preschool Children with Cerebral Palsy. *J. Speech, Language, and Hearing Research*, 52, 5 (2009), 1121-1138.
- Romski, M. et al. Parent Perceptions of the Language Development of Toddlers with Developmental Delays Before and After Participation in Parent-coached Language Intervention. *American J. Speech-Language Pathology*, 20, 2 (2011), 111-118.

Parent Training: Challenges in Real Life

Bringing up a Normal Child Together

M5: "*When I talk to [my younger child with language delay], I have to talk in a* ***very different way*** *[from how I talk to my* ***(normal) older son****]*"

Momentary Emotional Response

M1: "*I teach my daughter at home over and over, and she doesn't understand. (…) I get* ***upset*** *in spite of myself. (…) I* ***talk faster and push her****. (…)* ***She just shuts up****.*"

Slow Progress with Little Feeling of Success

M6: "*You can find from the Internet tons of things that claim to be effective. (I was so enthusiastic) but my son's change was too subtle. (…) I got* ***tired of pushing myself*** *so hard.*"

Taking a Year+ to Alter One's Own Conversation Style

M1: "*It took* ***almost two years****, but still I often make mistakes. (…) I wrote the guidelines on post-its, and put them everywhere in our home, to remind myself every moment.*"

Question

Can we help parent training in a more contextual way?

right in real-life conversation

through in-situ intervention

What would be a good place to start?

Sample video

Key Technology Requirement?

- **Speech recognition** ?
- **Semantic analysis** ?

- Yet not very satisfactory
  - Daily informal conversations
  - Children’s voices, difficult to recognize

Key Guidelines given by SLPs

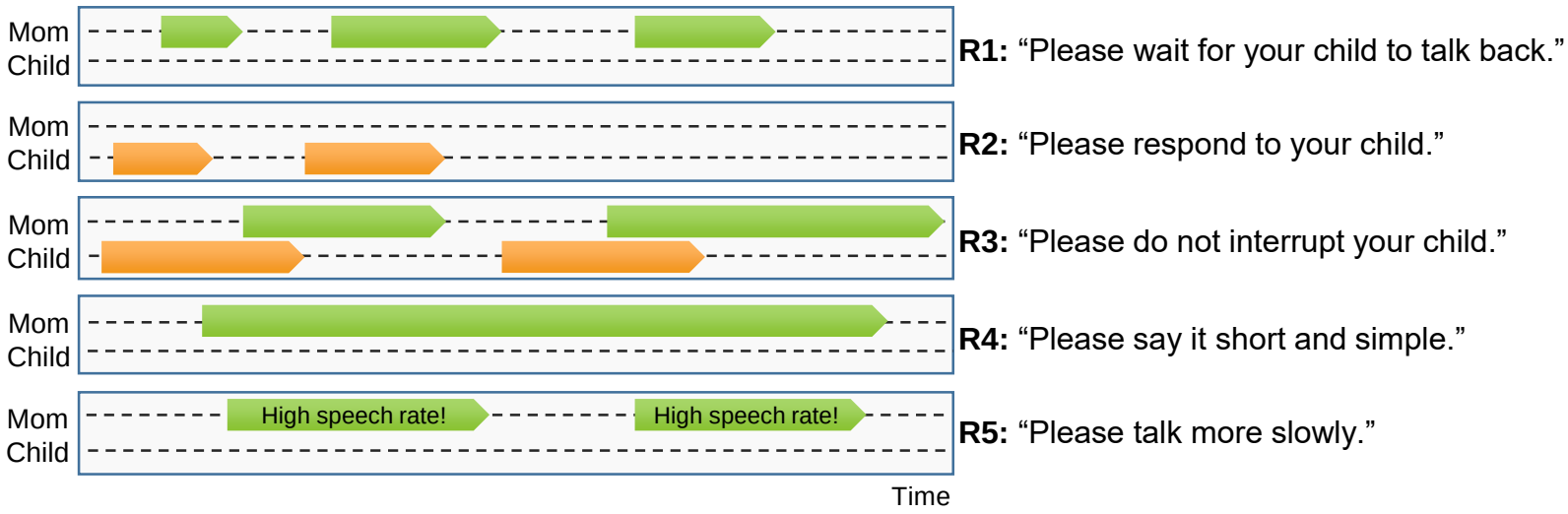
Q: Please write the top-7 guidelines you frequently give to parents

	Guidelines to the parents given by SLPs S1 ~ S8	S1	S2	S3	S4	S5	S6	S7	S8
Meta-linguistic	"Wait for the child to talk back."	X			X	X	X	X	X
	"Respond immediately when the child talks first."	X	X	X				X	X
	"Do not interrupt the child before she completes what she says."		X			X		X	X
	"Talk in short (and simple) sentences."	X	X	X	X	X		X	X
	"Talk more slowly."		X	X	X	X	X		X
	"Make more turn-takings with the child."			X			X		
	"Spend more time talking with the child."					X			
	"Articulate what you speak."		X					X	X
Semantic-aware	"Praise the child."				X		X	X	
	"Set a topic that the child is interested in."		X			X			
	"Use positive words."				X		X	X	
	"Refrain from making one-sided instructions."			X	X		X		
	"Repeat the important keyword."	X	X						X
Facial	"Make eye-contact with the child."				X	X	X		

Real-Time Turn Monitoring

Turn-taking Models:

- **learn from *linguistics, communications, psychology*!**
- **basic unit of conversation analysis**
  - **Turn, start, duration, pause, sequence, etc.**
  - **can use characterize many features of diverse types of conversations**



User Study: Service Acceptance

Expecting a Much Faster Mastery of Parent Training

M5: "*I would not have spent a year to get used to [the guidelines] if I had [TalkBetter].*"

Immediate Applicability without a Barrier of Pre-learning

M6: "*It's impossible to master everything (which claim effective). I love that this is ready-made.*"

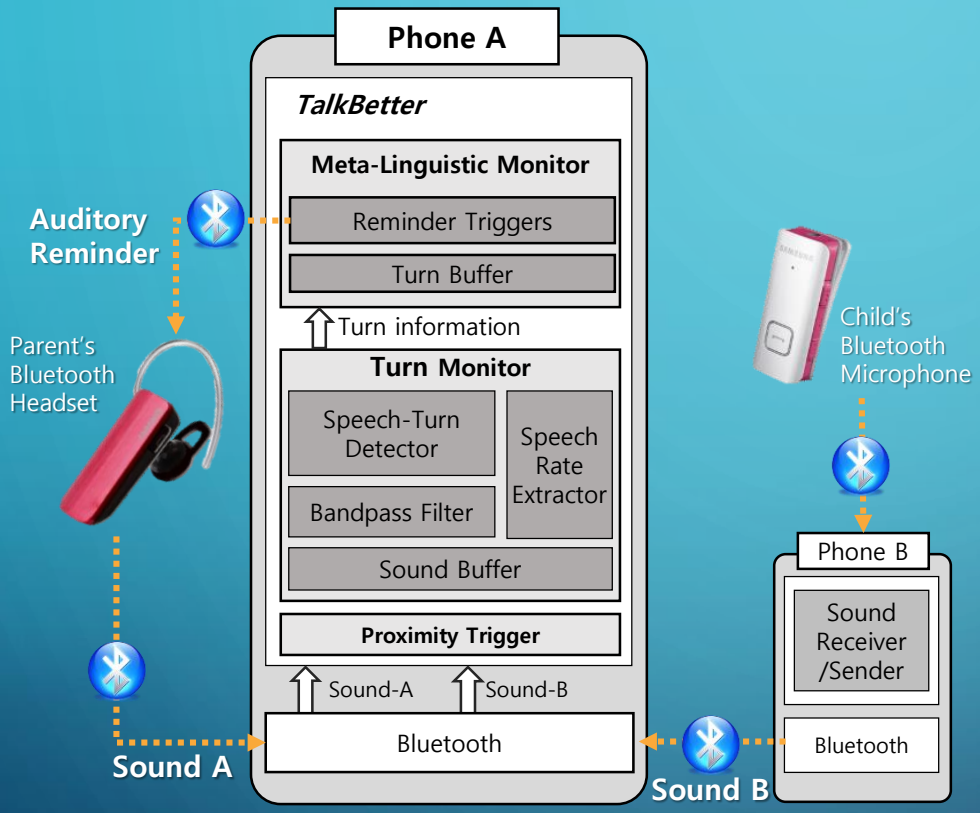
Language Independence

M11: "*My son is bilingual in Korean and English. I buy this, and it will work on both, right?*"

Reminders without Feeling Blamed

F1: "*When I make a mistake, [my wife] points out that I was wrong. Over and over, [I am taking it personal]. I like the reminders coming from the machine, not my wife.*"

Prototype System



Specifications

Galaxy Nexus with Android 4.1+

Bluetooth headset for parent

Clip-type Bluetooth mic. for child

Dual-phone implementation[1]

Aggressive band-pass filtering (250~500 Hz)[2]

300-ms frames for turn detection[3]

Speech rate based on syllable nuclei[4]

1. To circumvent the limitation of the default Bluetooth headset profile
2. French, N. R. et al. Factors Governing the Intelligibility of Speech Sounds. *J. Acoustical Society of America*, 19, 1 (1947)
3. Anguera, X. et al. Speaker Diarization: A Review of Recent Research. *IEEE Trans. Audio, Speech, and Language Processing*, 20, 2 (2012)
4. De Jong, N. H. et al. Praat Script to Detect Syllable Nuclei and Measure Speech Rate Automatically. *Behavior Research Methods*, 41, 2 (2009)

Initial Performance Evaluation

Turn-monitoring Performance

Session (parent ID)	Person	# of turns	Precision	Recall
M13	Parent	301	0.83	0.93
	Child	205	0.73	0.78
M14	Parent	293	0.83	0.87
	Child	139	0.69	0.77
M15	Parent	263	0.81	0.89
	Child	239	0.73	0.83

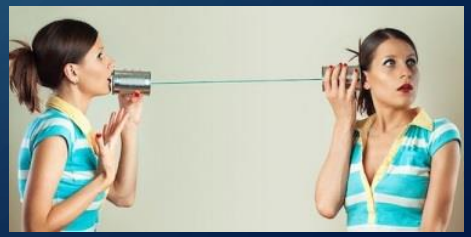
Children's lower precision & recall
- More physical activities
- Mumbling

Reminder-triggering Performance

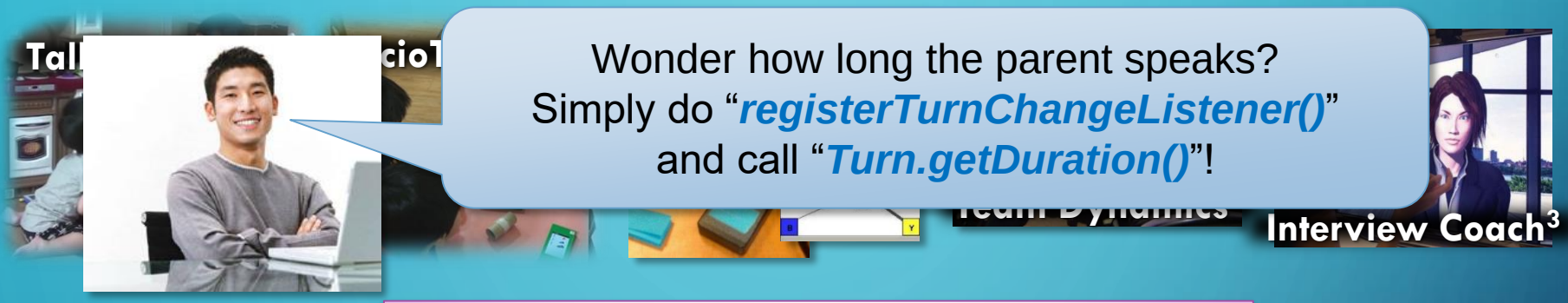
Session	Reminder by	The Number of Reminders					
		R1	R2	R3	R4	R5	Total
M13	SLP	0	0	4	2	5	11
	TalkBetter	1	1	3	2	4	11
	Match	0	0	3	2	3	8
M14	SLP	7	1	0	1	0	9
	TalkBetter	5	2	0	1	0	8
	Match	3	1	N/A	1	N/A	5
M15	SLP	2	8	3	0	0	13
	TalkBetter	3	7	2	0	0	12
	Match	2	6	1	N/A	N/A	9

Lower precision (55%) of R1:
"*Please wait for your child to talk back.*"
- Nonverbal response from children makes a reminder unnecessary

Extension: interaction-aware apps



Extension: an interaction-aware platform



Intuitive Meta-linguistic Monitoring APIs

Face-to-Face Conversation Monitoring Platform
(over participants' mobile phones)

Abstracting signal processing & resource management

1. Kim, T. et al. Meeting Mediator: Enhancing Group Collaboration using Sociometric Feedback. *CSCW* 2008.
2. Olguin, D. O. et al. Sensible Organizations: Technology and methodology for automatically measuring organizational behavior. *IEEE Trans. Systems, Man, and Cybernetics*, 39, 1 (2009).
3. Hoque, M. et al. MACH: My Automated Conversation coach. *UbiComp* 2013.

What to capture?

Basic

- Co-presence
- # of people
- Relationship
- Place
- …

Aural cues

- Voice quality
- Pitch
- Intonation
- …

Verbal cues

- Spoken words
- Semantics
- Topics
- …

Visual cues

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

Meta-linguistic Conversation Monitoring

A Few Guess

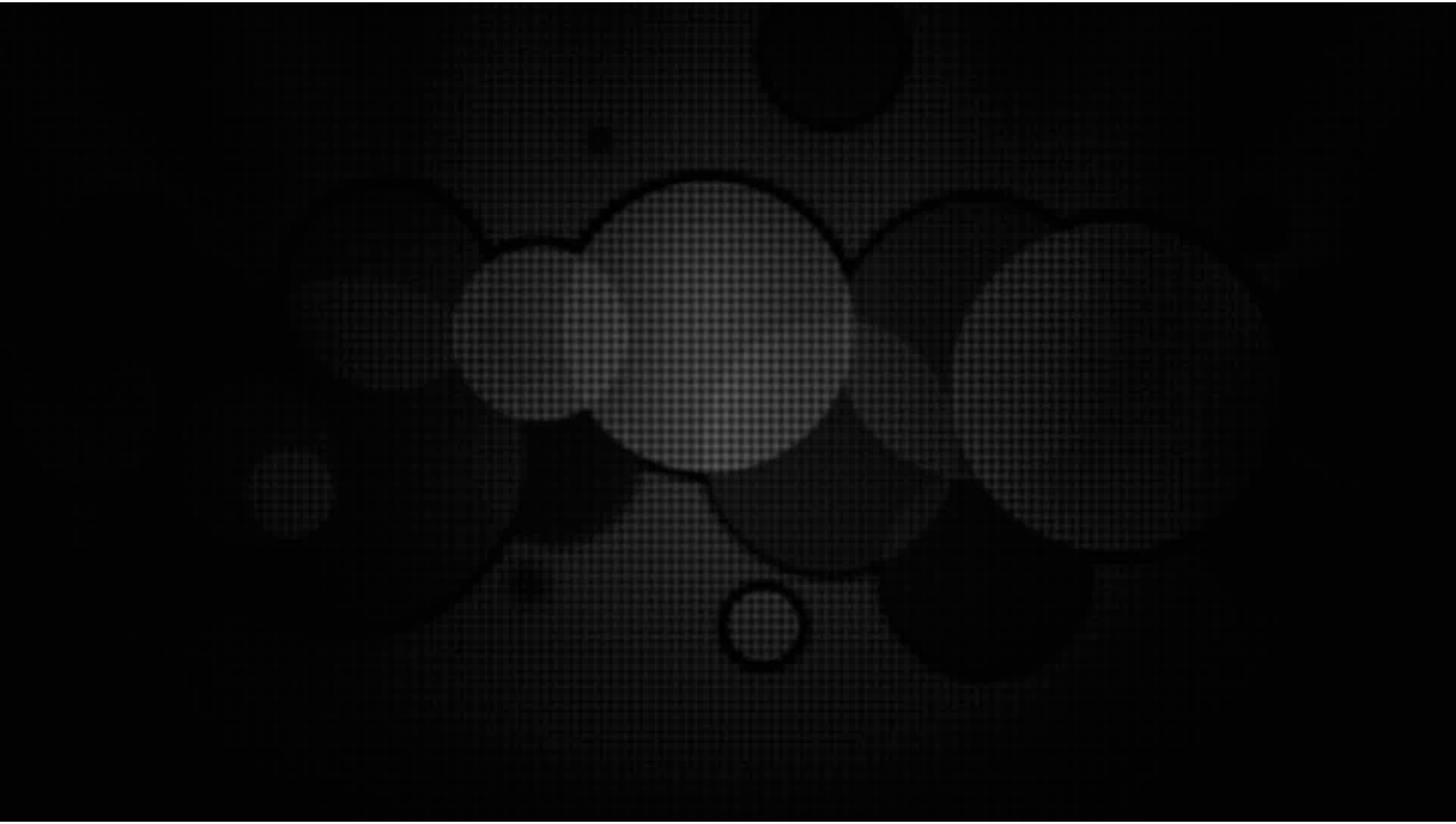
- The woman seems taking control of the conversation.
- The man attempted to appeal, with little success.
- The woman gave a flat refusal, interrupting the man's talk.
- The woman ended the conversation on her will.

Woman:
Man:

SocioPhone Key APIs

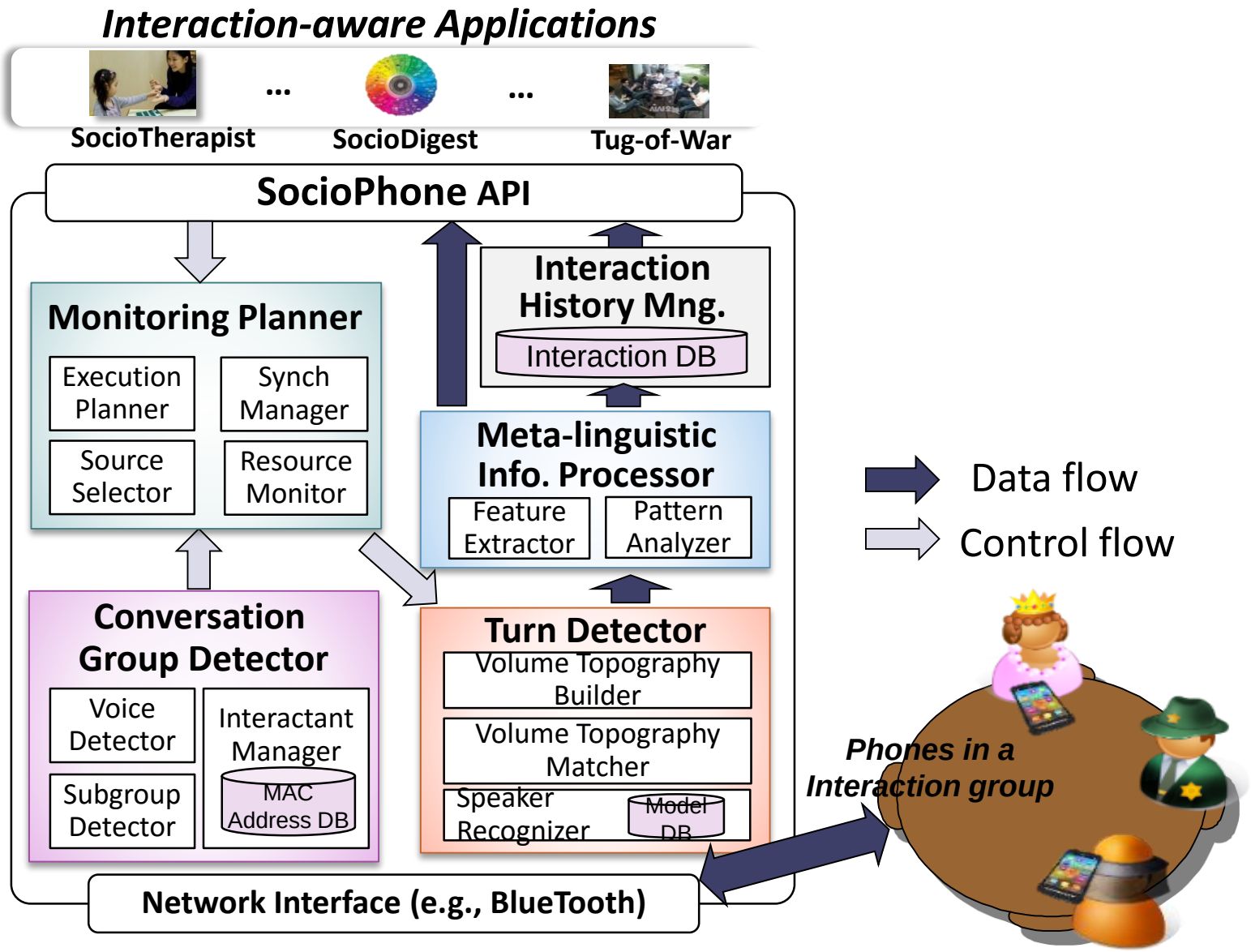
- Monitoring conversation turns
  - *registerTurnChangeListener* (callback(Turn))
    - Turn = (Timestamp, speaker, start_time, end_time)
- Monitoring turn-derived contexts
  - *getSparsity* (window_time | window_turns)
  - *getInteractivity* (window_time | window_turns)
  - *getAsymmetry* (window_time | window_turns)
  - *registerDominanceListener* (callback(Interactant), Inferrer)
  - *registerLeadershipListener* (callback(Interactant), Inferrer)
  - …
- Querying interaction history
  - *getOnGoingSessionHistory*(“SQL_Query_Statement”);
  - *getPastInteractionHistory*(“SQL_Query_Statement”);

SocioTherapist



- 족보 ref.

Prototype Implementation



Promoting Interpersonal Touch for Vibrant Workplace

Touch is Our Social Language

*Do you usually do **touch interaction** in workplace?*

Limited Touch Interactions in Workplace

*Aren't we losing something by **discouraging touch too much**?*

Touch Hunger

Overlooking effects of touch interaction

< Field, T. Touch. MIT (2001) >

Promoting High-five in Workplace

Boosting

Interactive

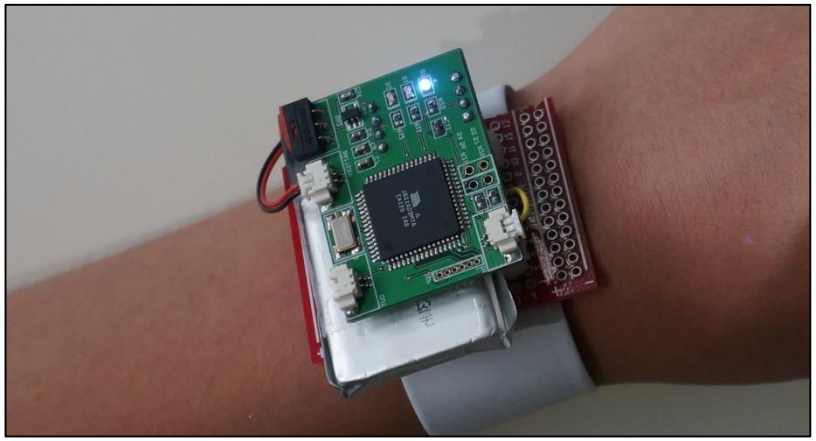
Vibrant culture

Touch-Sensing Platform

Find Potential of Touch-sensing Platform

✓ *Utilizing electric skin potential level*

Prototyping watch-style sensor



Electric skin potential sensor

Scenario 1.

Check Attendance

What do you expect, if you do high-fives everyday?

Without looking at anyone

With Eye-Contact

*Doing high-fives makes morning atmosphere **much better***

Closing

- Human, Relations, and Interactions
  - Humanities, Psychology, Social Sciences
  - (Internet) Social Computing
  - What can we further extend with IoT?

Toward Life-Immersive IoT Computing