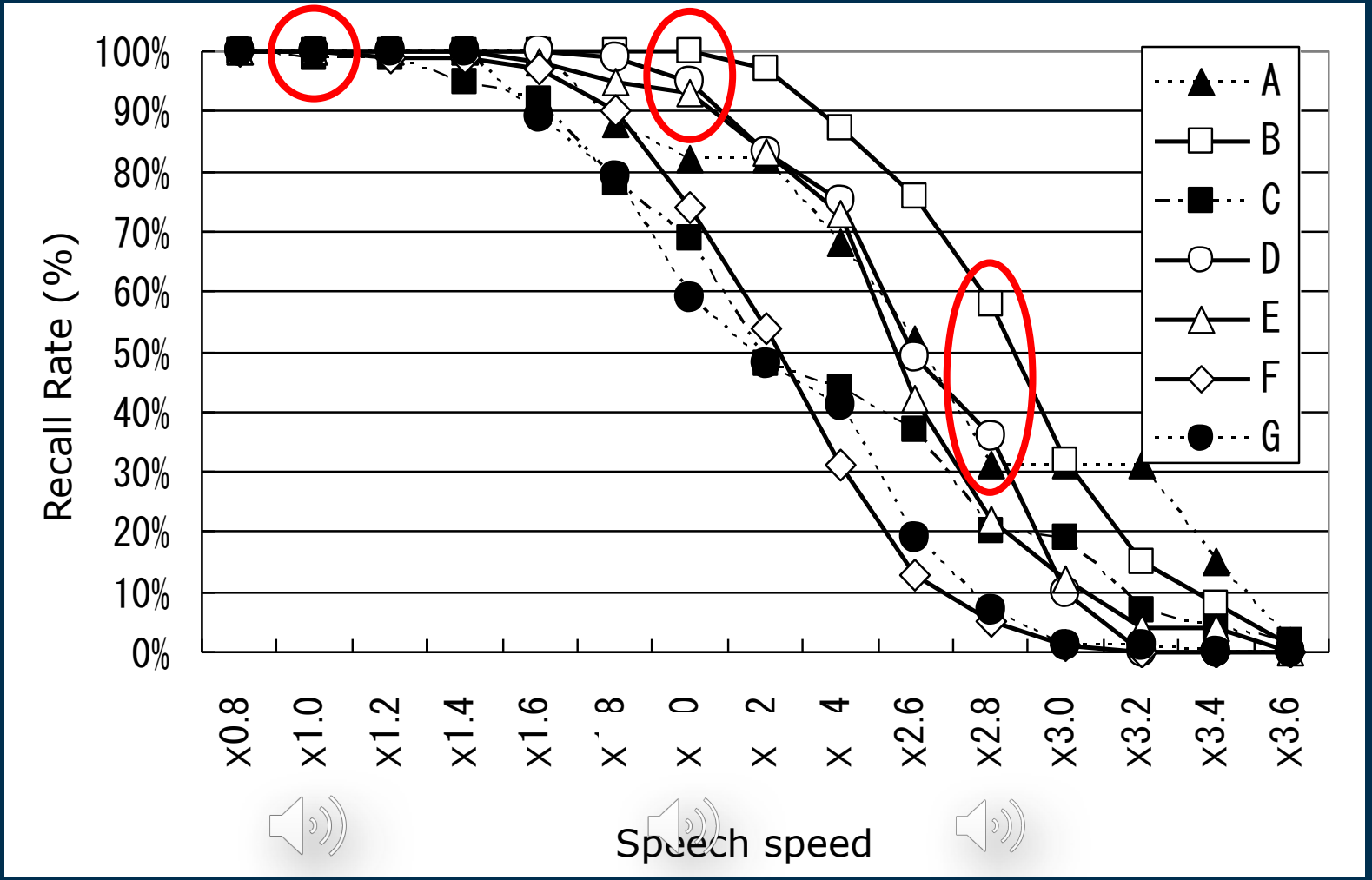
Cognitive Assistance for the Blind

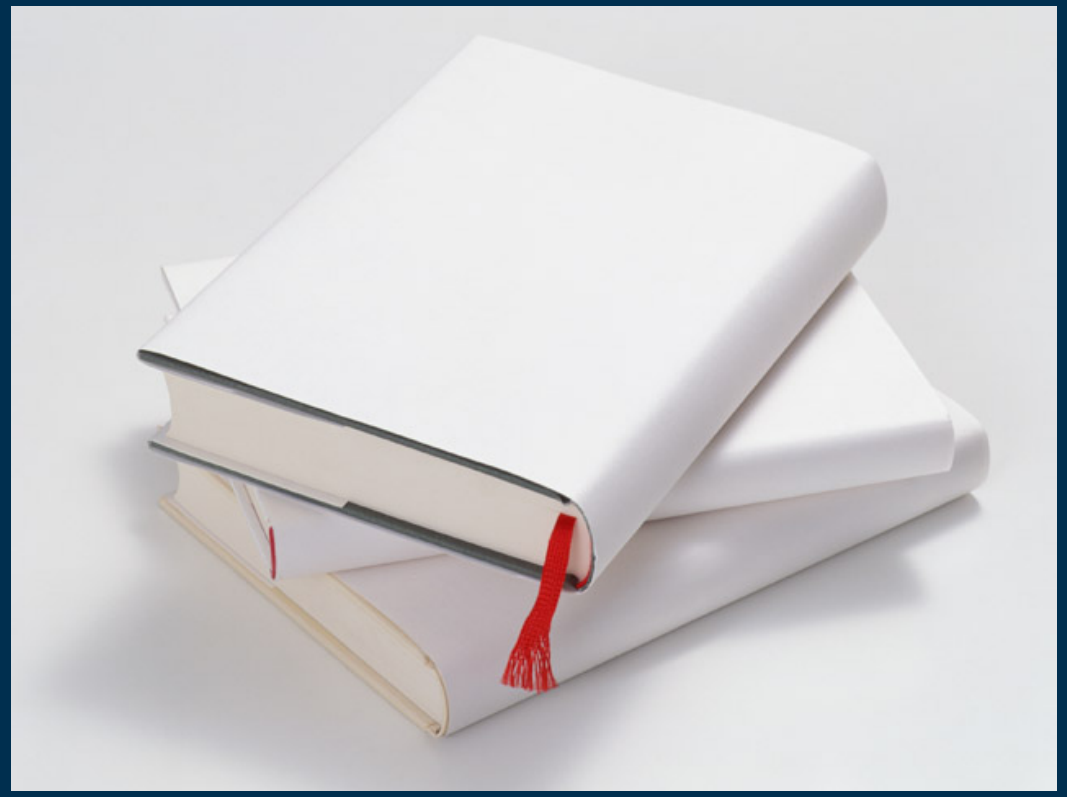
Chieko Asakawa
IBM Fellow, IBM Research and CMU

Cognitive Ability of Visually Impaired People



Asakawa, Chieko, Hironobu Takagi, Shuichi Ino, and Tohru Ifukube. "Maximum listening speeds for the blind." *International Conference on Auditory Displays*, 2003.

Information accessibility

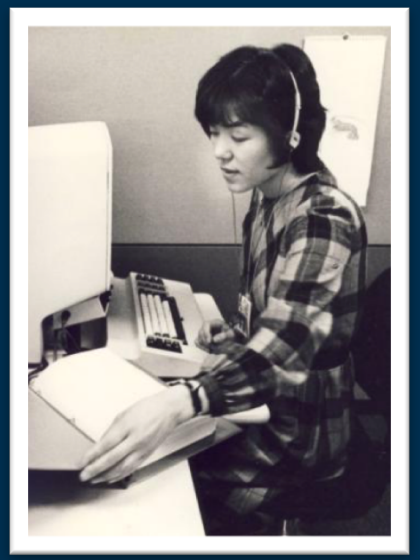


Mobility

IBM History of Accessibility

1960s
Talking Typewriter

1975
1403 Braille Printer



1984
Talking 3270 Terminal

1984
Online Braille Library

1997…

Home Page Reader

- **The first practical voice browsers in the world**
- **Became a product in 1997 and translated into 11 languages**

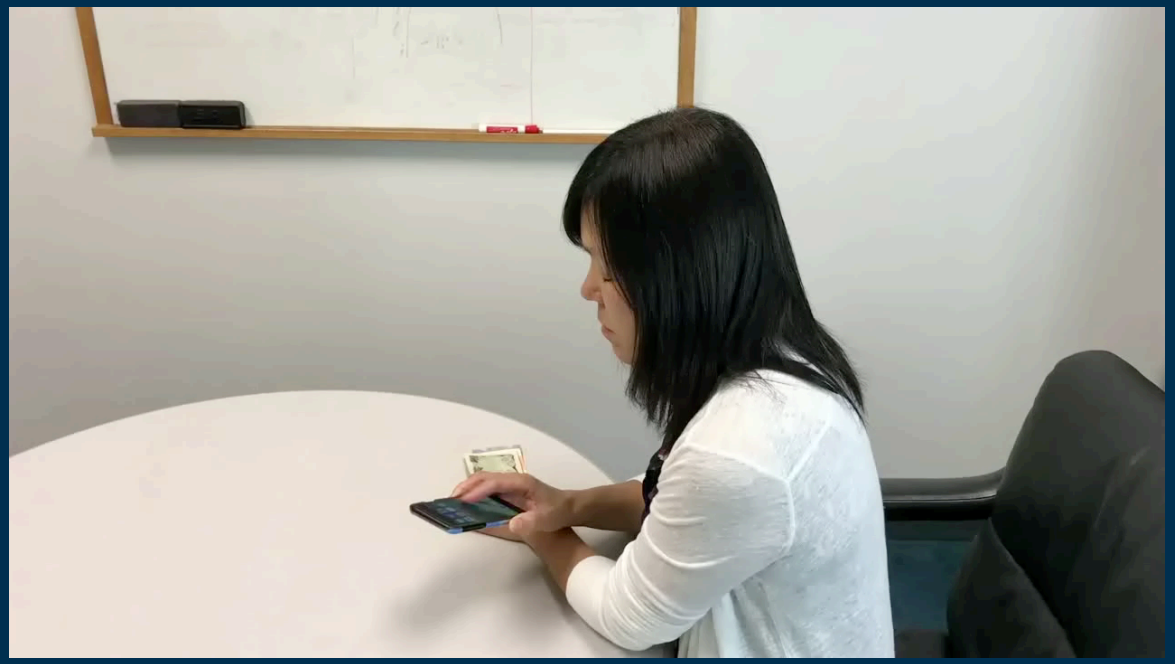
IBM Home Page Reader (1999)
Japanese, Italian, French, German, Spanish, English (U.S., U.K.)

"Home Page Reader is my small window to the world.
I can read, write, and access information.
I can do everything to participate in society."

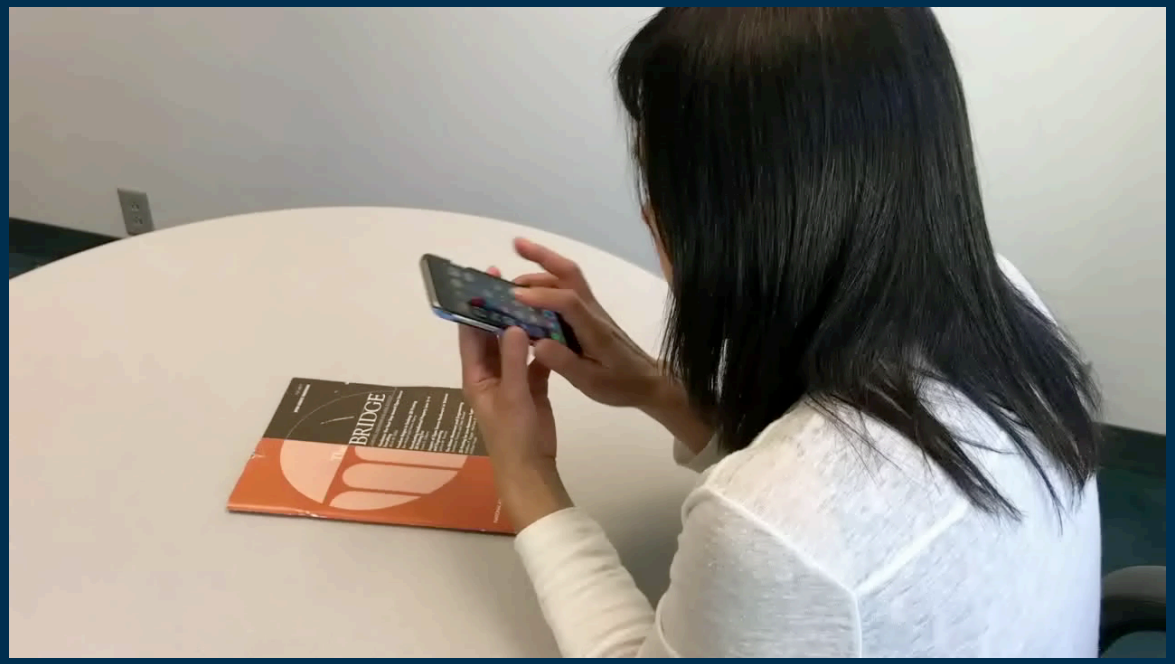
— comment from a user, 1997

Asakawa, Chieko, and Takashi Itoh. "User interface of a home page reader." *Proceedings of the third international ACM conference on Assistive technologies*. ACM, 1998.

Demonstration: Smartphone Apps for the Blind



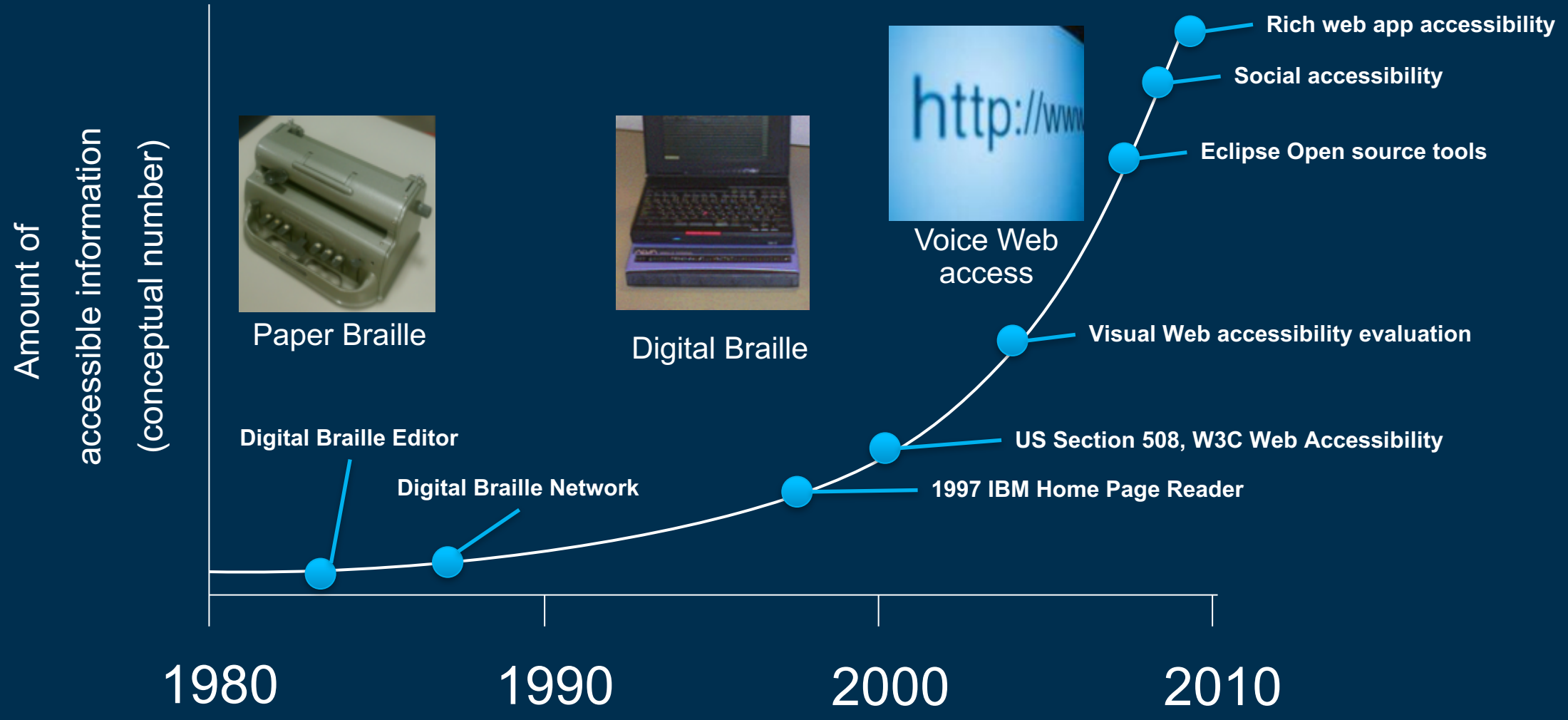
Money Reader



KNFB Reader

Demonstration: Dictation on Smartphone

Exponential Growth of Accessible Information



Real World Accessibility

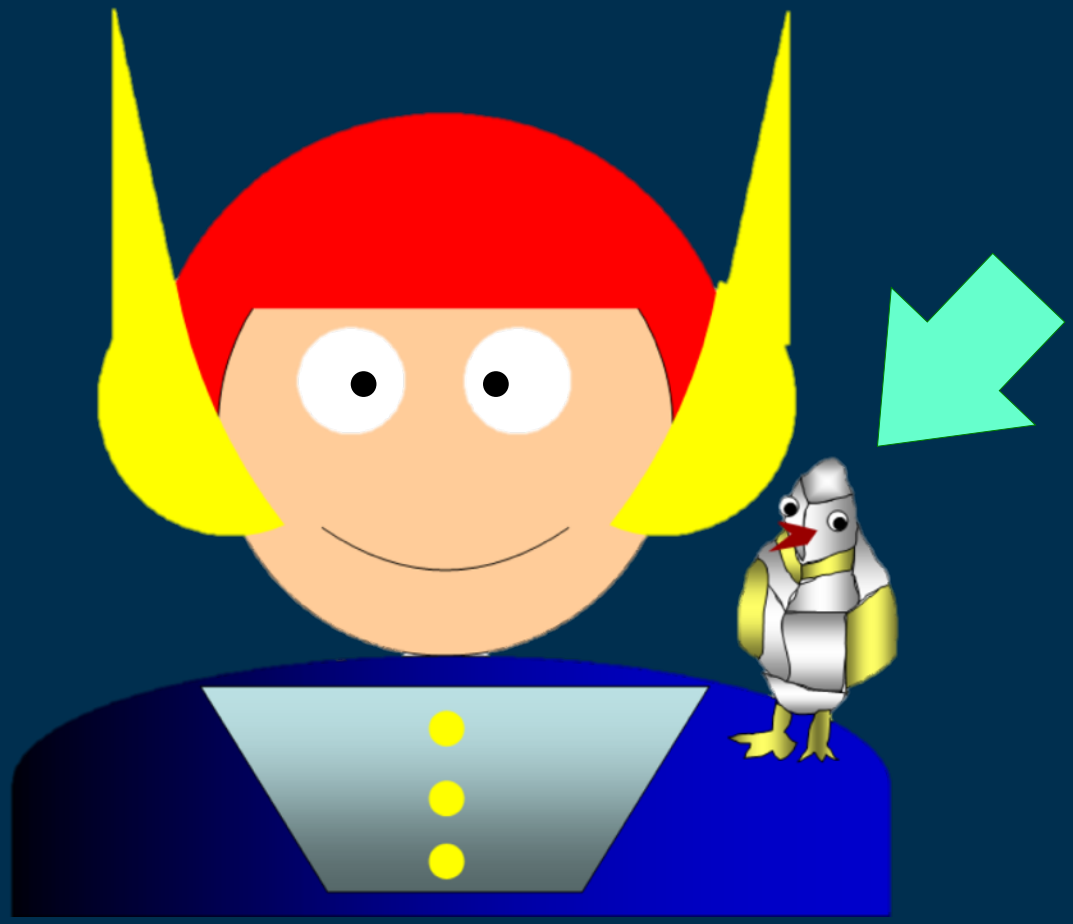
Walk by myself

Shopping

Finding restaurants

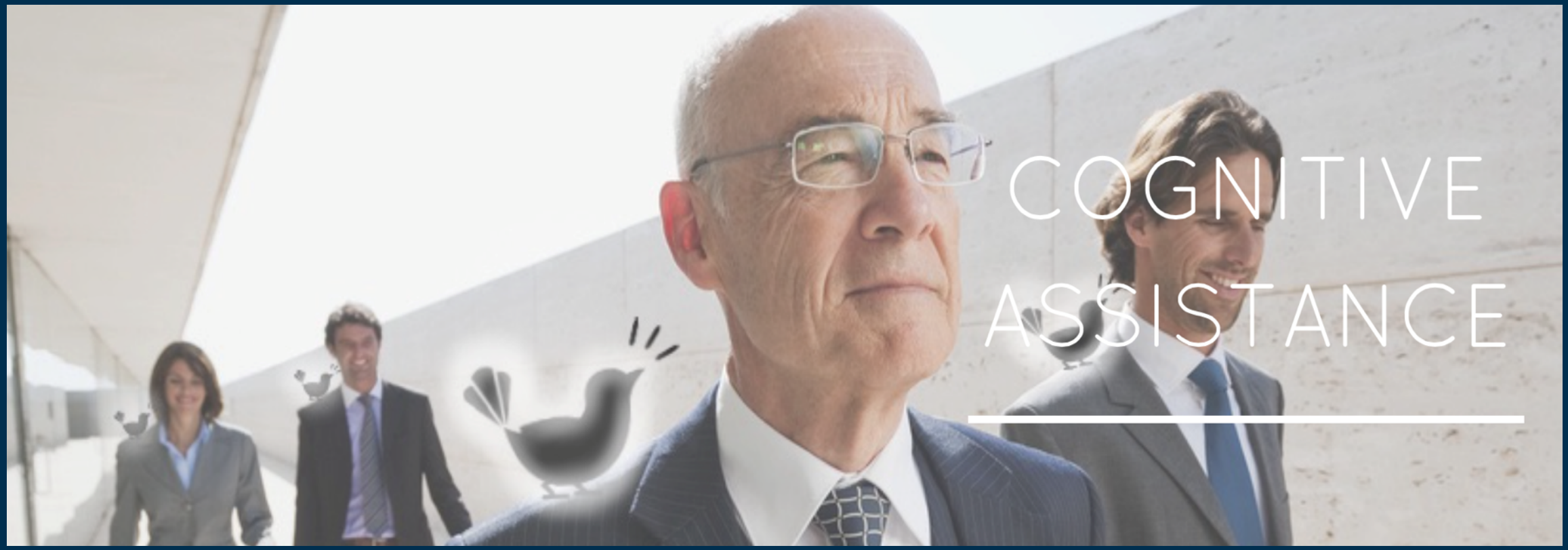
Finding discount signs

Small Bird Bot



Pulling a string of my childhood memory of watching “Esper the Light Speed”

Cognitive Assistant



Augment missing or weakened abilities by the power of cognitive computing.

TED 2015 “How new technologies helps blind people explore the world”
https://www.ted.com/talks/chieko_asakawa_how_new_technology_helps_blind_people_explore_the_world

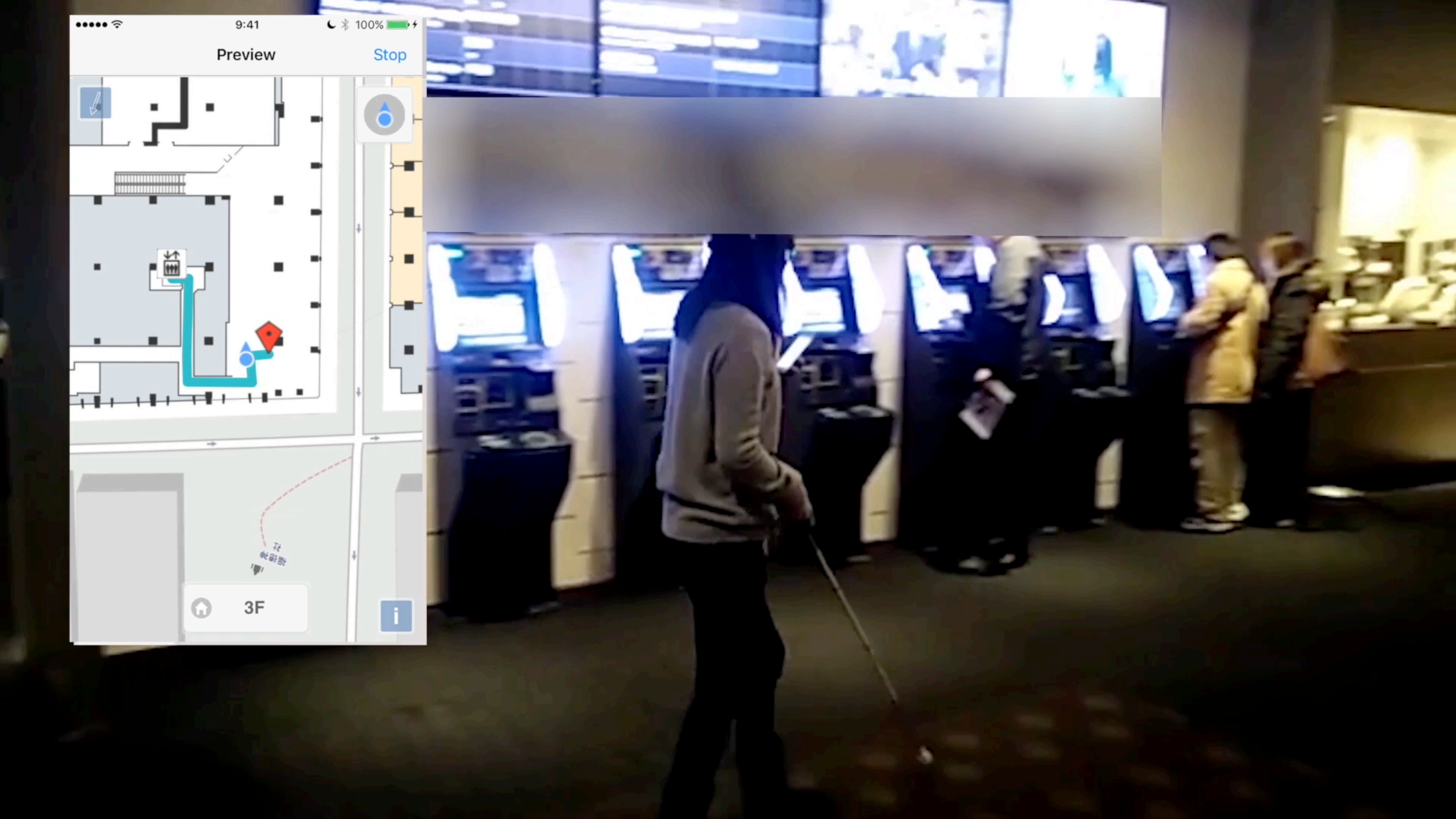
Nihonbashi Pilot

Source: MITSUI FUDOSAN (http://www.mitsuifudosan.co.jp)

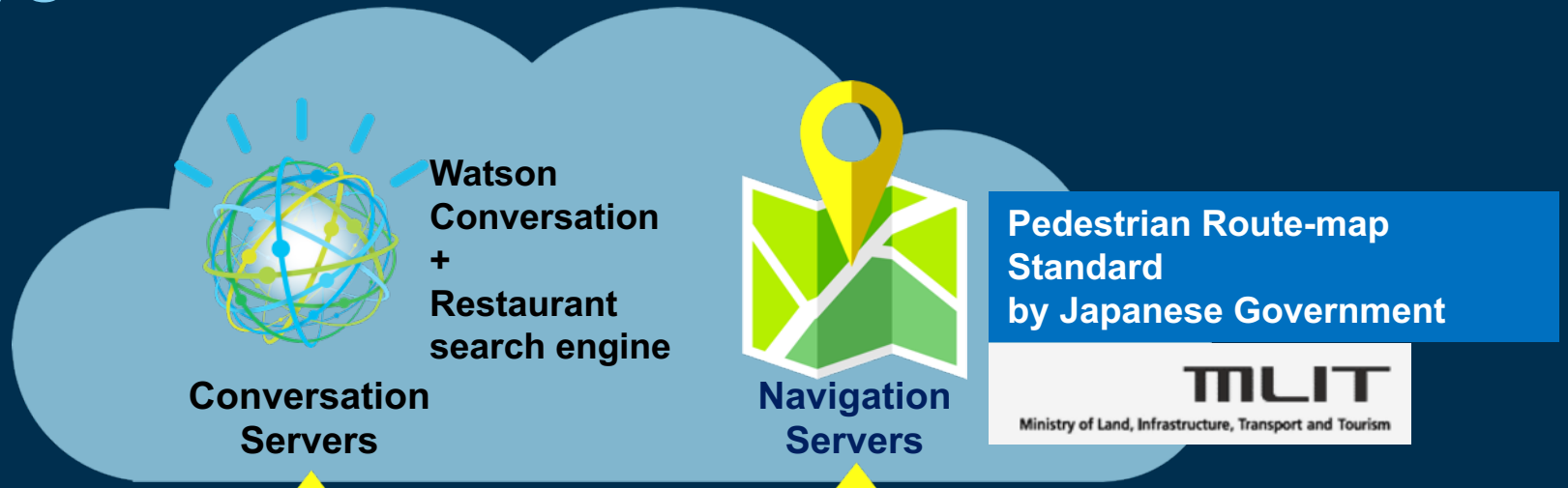
Source: Mitsui Shopping Park Urban (https://31urban.jp/)

- February 1st - February 28th, 2017.
- Conversational destination search + Accurate indoor navigation
- Blind, wheelchair and foreign visitors
- 21,000m^2 (Three buildings x five floors)
- 92 shops and restaurants

Masayuki Murata, Daisuke Sato, Hironobu Takagi, Dragan, Kris Kitani, Chieko Asakawa , “Smartphone-based Indoor Localization for Blind Navigation across Building Complexes”, *Percom* 2018


9:41
100%
Preview
Stop
3F

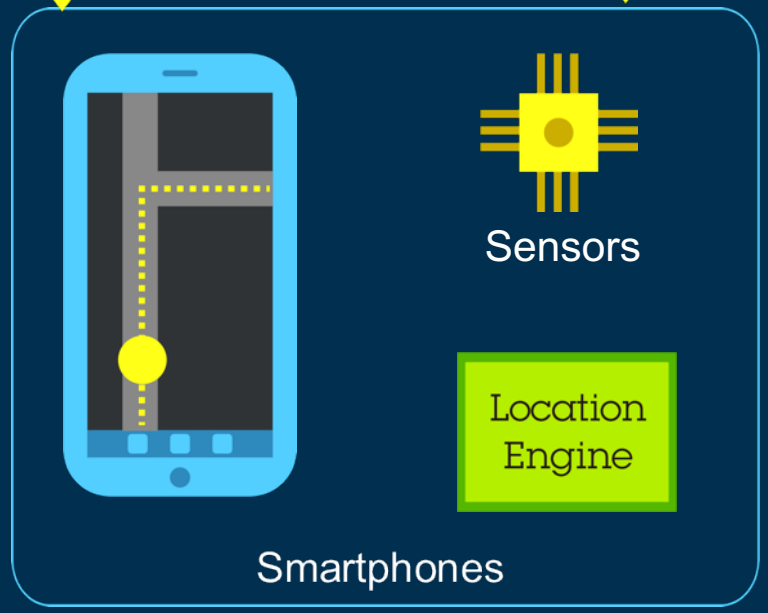
Architecture

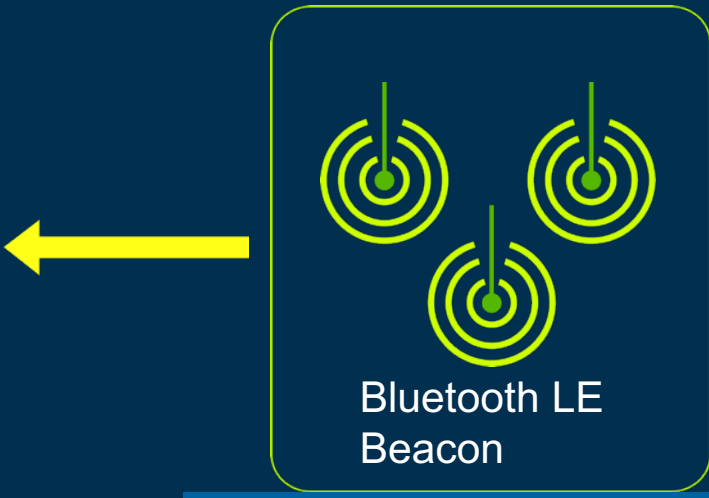


Blind, wheelchair users,
and other pedestrians
(Japanese and English)

Find a destination
by conversational
interface

Voice-based
indoor turn-by-turn
navigation

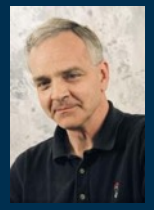




5-10 meter intervals
224 beacons for 21.000m2

CMU Cognitive Assistant Lab.

Advisors



Martial Hebert
Robotics Institute
Director

Takeo Kanade
Former director

Faculty members

Kris Kitani
Robotics Institute

Postdocs

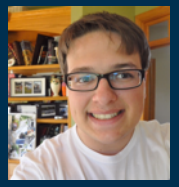
Dragan Ahmetrovic

Eshed Ohn-Bar

João Guerreiro

Uran Oh

PhD Students



Cole

Nick

Supported by
Shimizu Corporation

IBM Research Members

Hiro Takagi

Daisuke Sato

Masayuki Murata

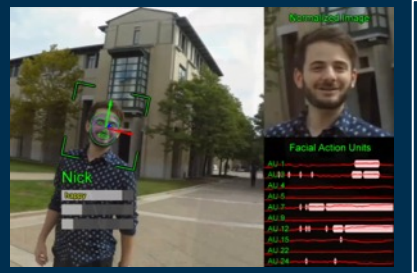
Tatsuya Ishihara

Marco Visentini

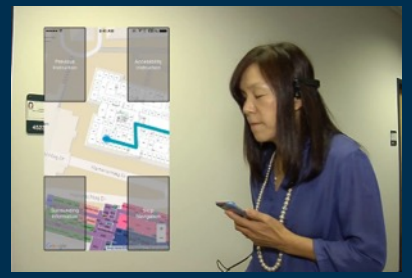
NavCog at Annual PCB Conference
https://www.youtube.com/watch?v=KkRigGqTsuc

Foundation of Cognitive Assistant

Knowledge
Personal
Social media
Encyclopedic



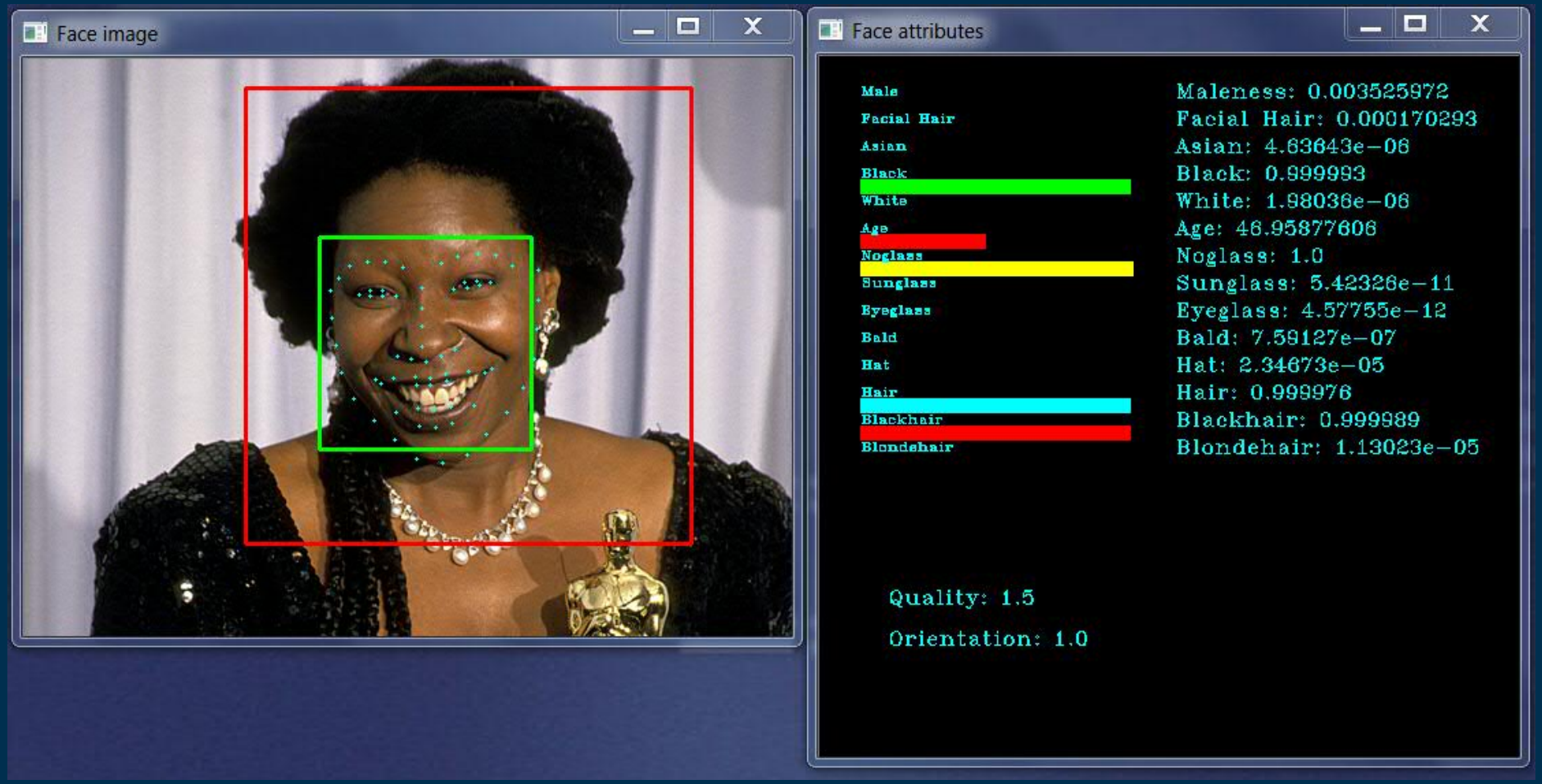
Recognition
Objects
People
Environment



Localization
Radio-wave
Vision
Dead reckoning

Interaction
Speech
Gesture
Sonification

Face Recognition and Fine-Grain Attributes Extraction



Text and Logo Extraction

Text

“happy birthday kristin"

“texas"

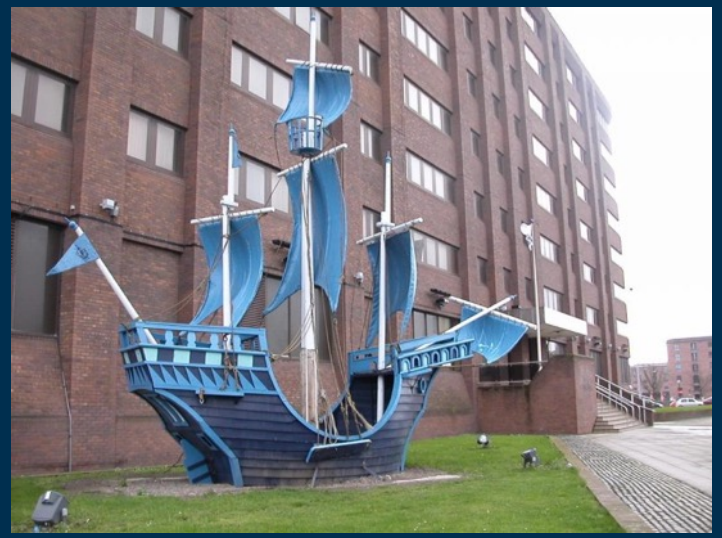
Logo

“adidas”

“Canadian Tire”

*images from COCO-Text dataset

Natural Language Captioning



"A blue boat is sitting on the side of a building"

"A green bird sitting on top of a bowl"

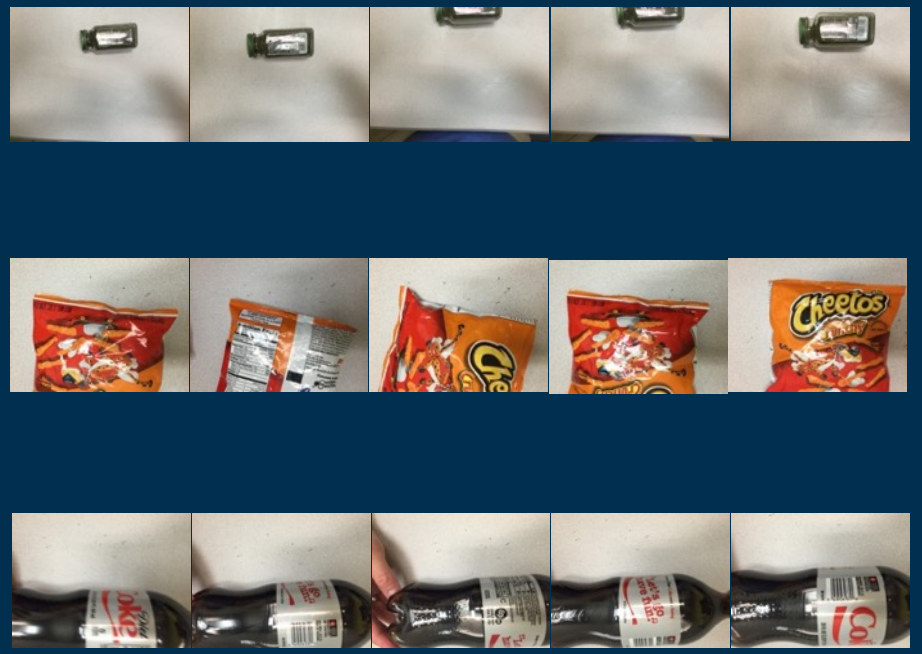
"A woman sitting on a table with a giraffe"

IBM Research has top entry to MS-COCO Image Captioning Challenge (April 2017)

Personal Object Recognition

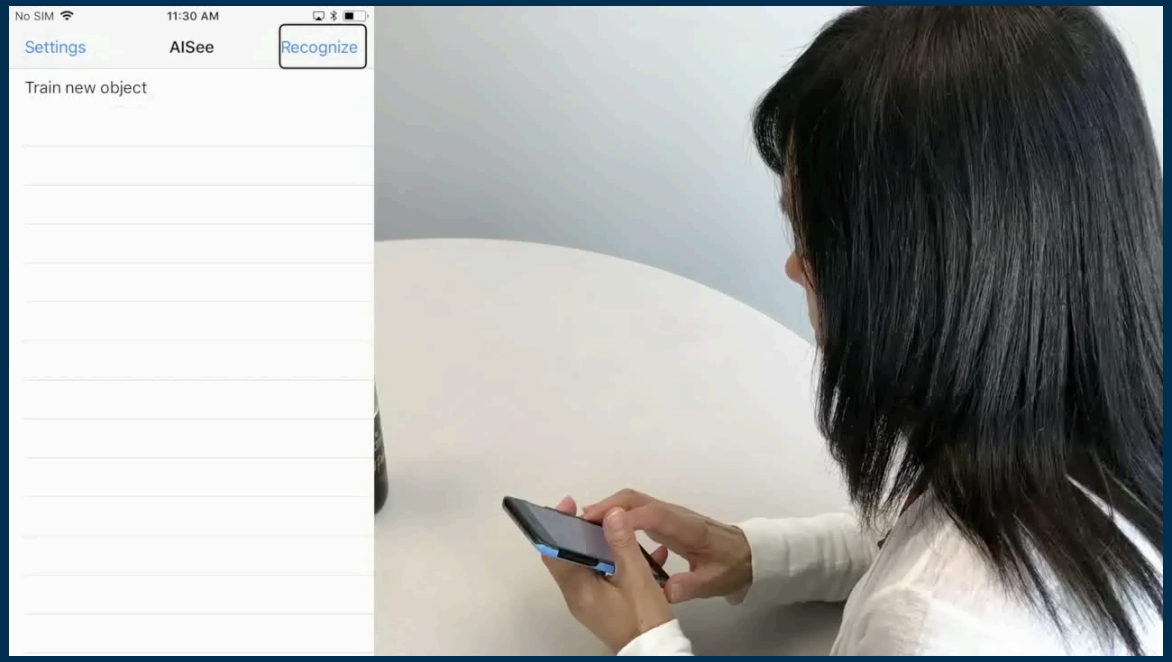
Incorrect results Before leaning		Correct results After learning
“Pen sharpener”		Spice bottle
“Christmas socks”		Cheetos
“Beer bottle”		Diet coke

Photos for learning taken by blind subjects



Kacorri, Hernisa, et al. "People with Visual Impairment Training Personal Object Recognizers: Feasibility and Challenges." *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. ACM, 2017. Honorable mention

Demonstration: Personal Object Recognizer

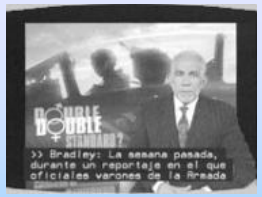


Training mode

Recognition mode

Innovations Flourish From Accessibility Needs

AI



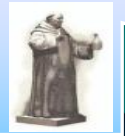
Captions for TV programs were invented for deaf people, but are now widely used in sports bars and to help immigrants, etc.

2011, voice dialog technologies for smartphones

First consumer product was a reading assistant for the blind in the 1970s.

Early use of keyboards was a to help people with hand-and-motor disabilities in writing

17th century, Dom Perignon.



1876, Alexander Graham Bell invented the phone after teaching hearing impaired people.

18th century, the mathematician Euler authored a leading textbook on mathematics after he became blind.

18th

Champagne

Modern Mathematics

20th

Keyboard

Telephone

Voice synthesis and OCR

TV Captions

21st

Voice dialog

Voice recognition

Segway

Autonomic vehicles

"Blind driving challenges"

Based on Self-standing wheelchair.

History of Voice Synthesis

1960 1970 1980 1990 2000 2010 2020

1961
Vocoder

https://www.youtube.com/watch?v=ebK4wX76RZ4

Bell Labs.
By using IBM 704 Computer.

Wikipedia

1983
DEC talk

DEC
RS232C device for PCs.

Wikipedia

2017
Watson TTS

https://www.ibm.com/watson/developercloud/text-to-speech.html

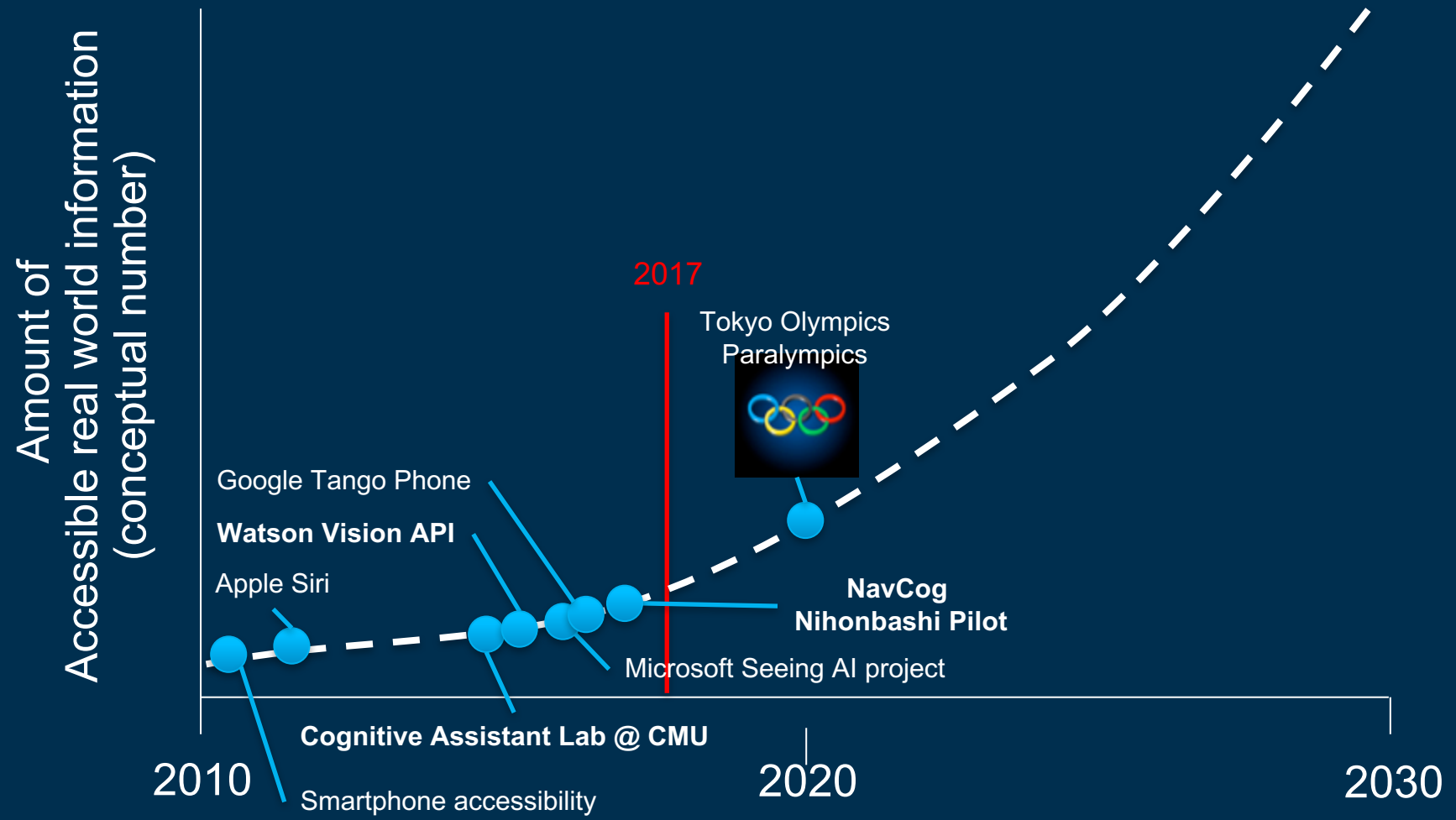
IBM
Text-to-speech API

World Robot Summit 2020

Aichi International Exhibition Center
Early October 2020 for one week
http://worldrobotsummit.org/en/

Service Robotics Category

Future Exponential Growth of Real-world Access



IBM **Research** AI