Technology and Value of Service-Oriented Smart System

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KOBE UNIVERSITY AND UNIVERSITY OF GRENOBLE-ALPES
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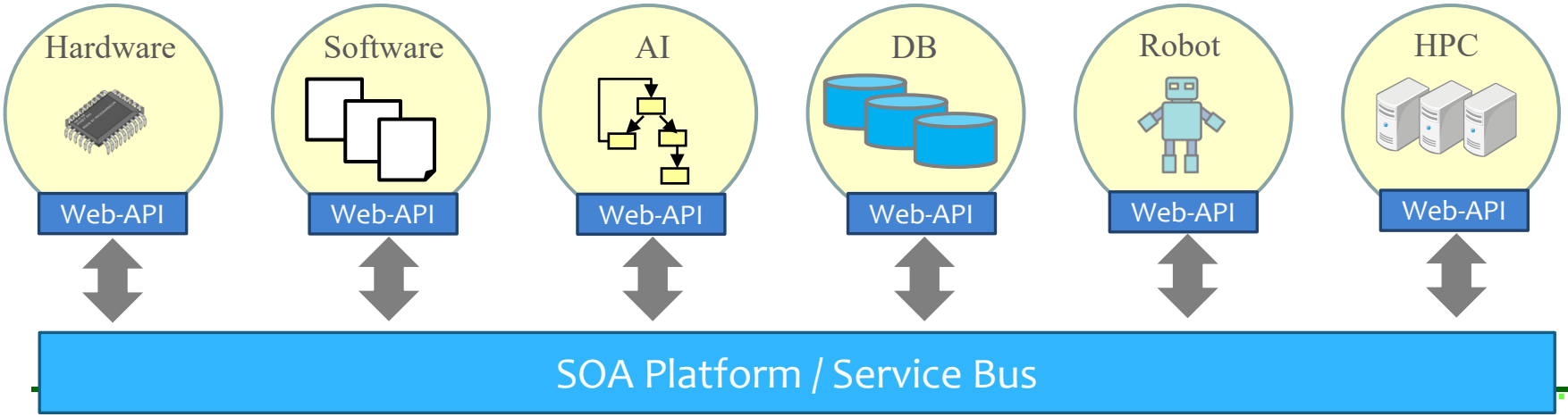
- Associate Professor at **Kobe University**
  - **Teaching:** Software Engineering, Java Programming, Cloud Computing, Big Data Analysis
  - **Research:** Service/Cloud Computing, Life Logging, Smart Systems, IoT
  - **Hobby:** Travel, Ski, Games

- **Collaborating L. du Bousquet and P. Lalanda**
  - Visited VASCO & ADELE for 10 months in 2015
  - V&V of Self-Adaptive Smart Systems

Service-Oriented Smart System

- Service-Oriented Architecture (SOA, 2002)
  - SW architecture integrating heterogeneous distributed systems
  - Think every feature of a system as a service (XaaS)
  - Compose services for a new service
  - Originally used for enterprise application integration
- Service-Oriented Smart System
  - Apply principle of SOA to smart systems
  - Wrap heterogeneous computing resources as services
  - Loose-coupling and dynamic discovery/integration



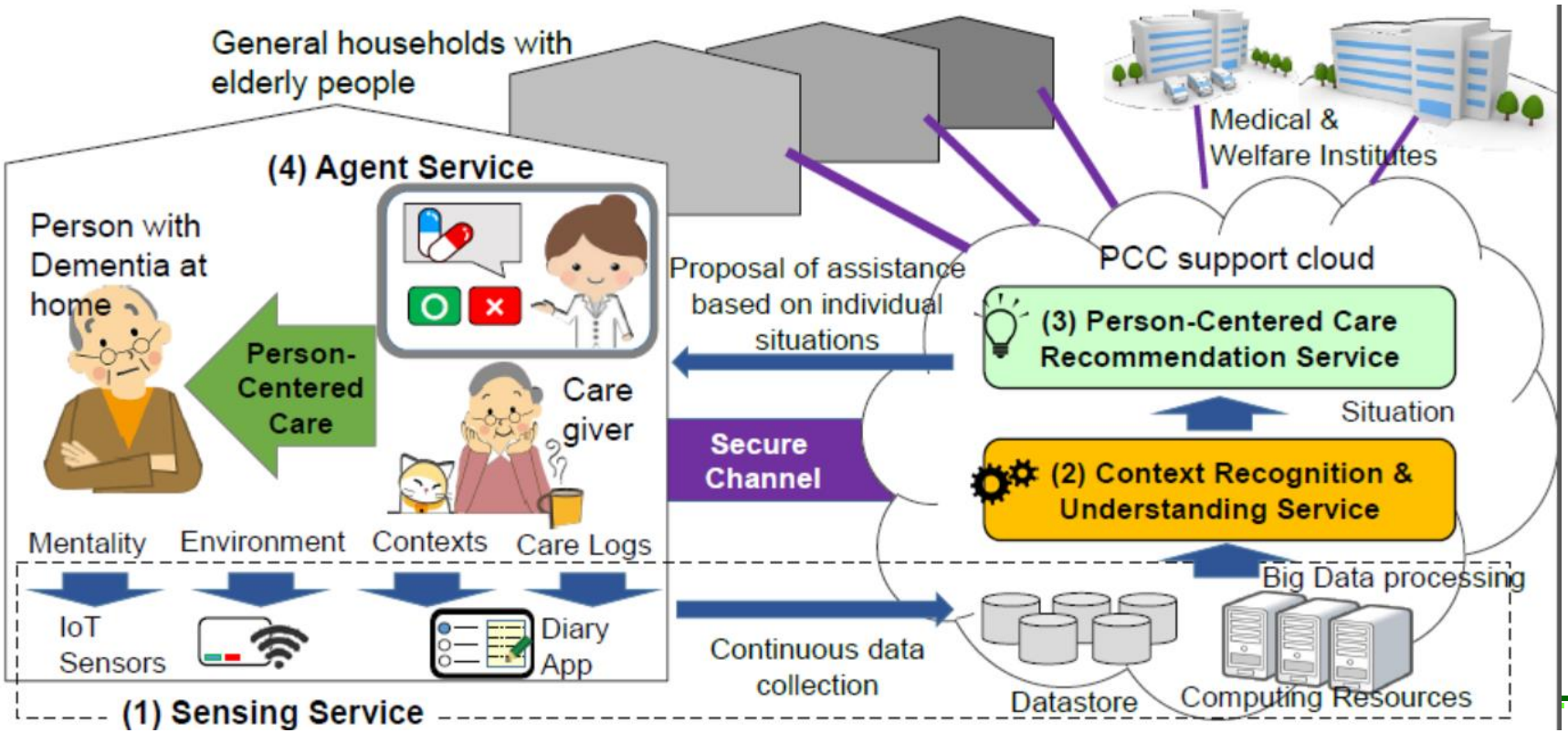
CS27-HNS (Home Network System)

- Smart home testbed operated in my laboratory
  - All sensors and appliances are deployed as Web services

Person-Centered Care Support System

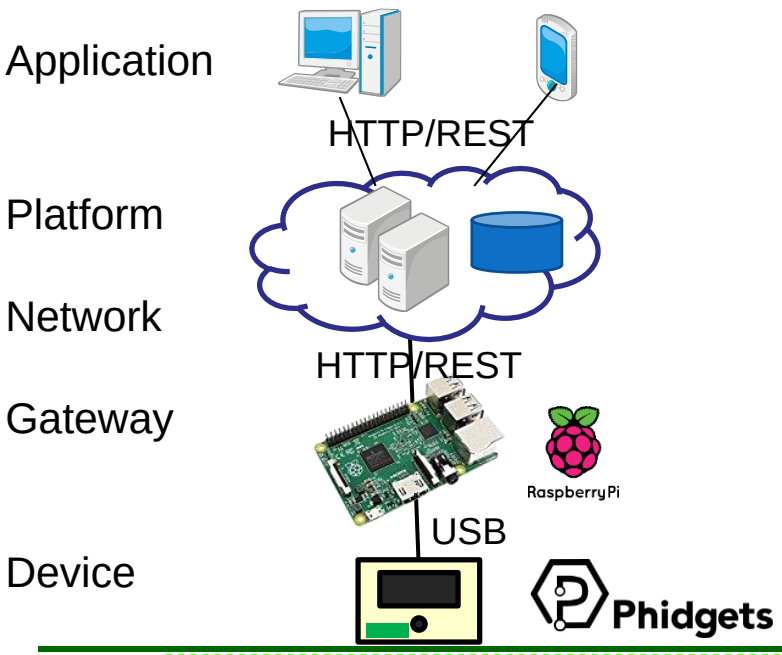
- Supporting elderly at home with IoT and Virtual Agent
  1. Sensing Service
  2. Context Recognition Service
  3. PCC Plan/Recommend Service
  4. Agent Service

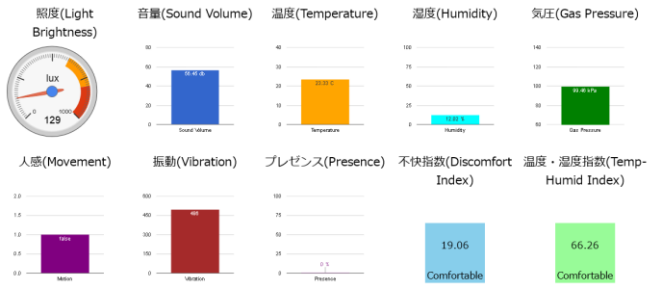
Provide personalized cares for individual elderly

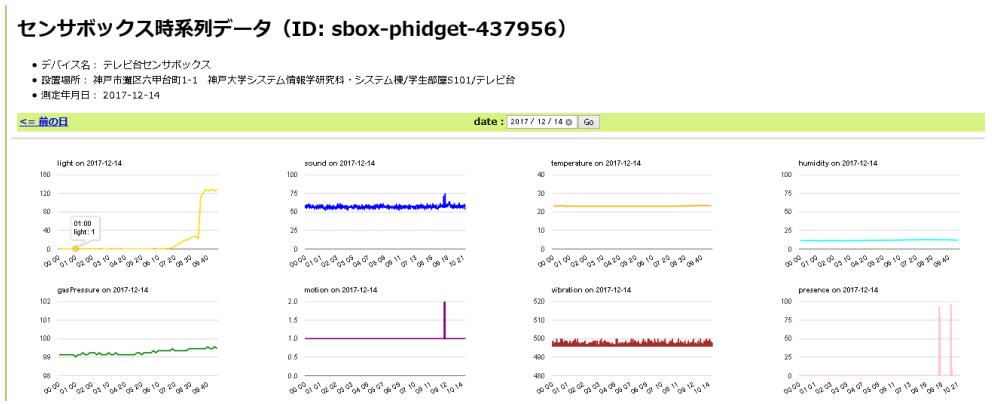


SensorBox for Sensing Service

- IoT for autonomous/non-invasive environmental sensing
  - 7 sensors (light, temp., humid, sound, motion, pressure, vibration)
  - Raspberry Pi 3 for gateway
  - Data platform provides RESTful services
  - Instant / time-series values

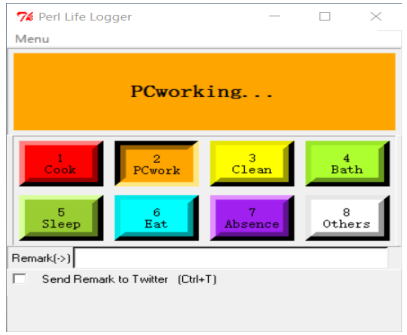




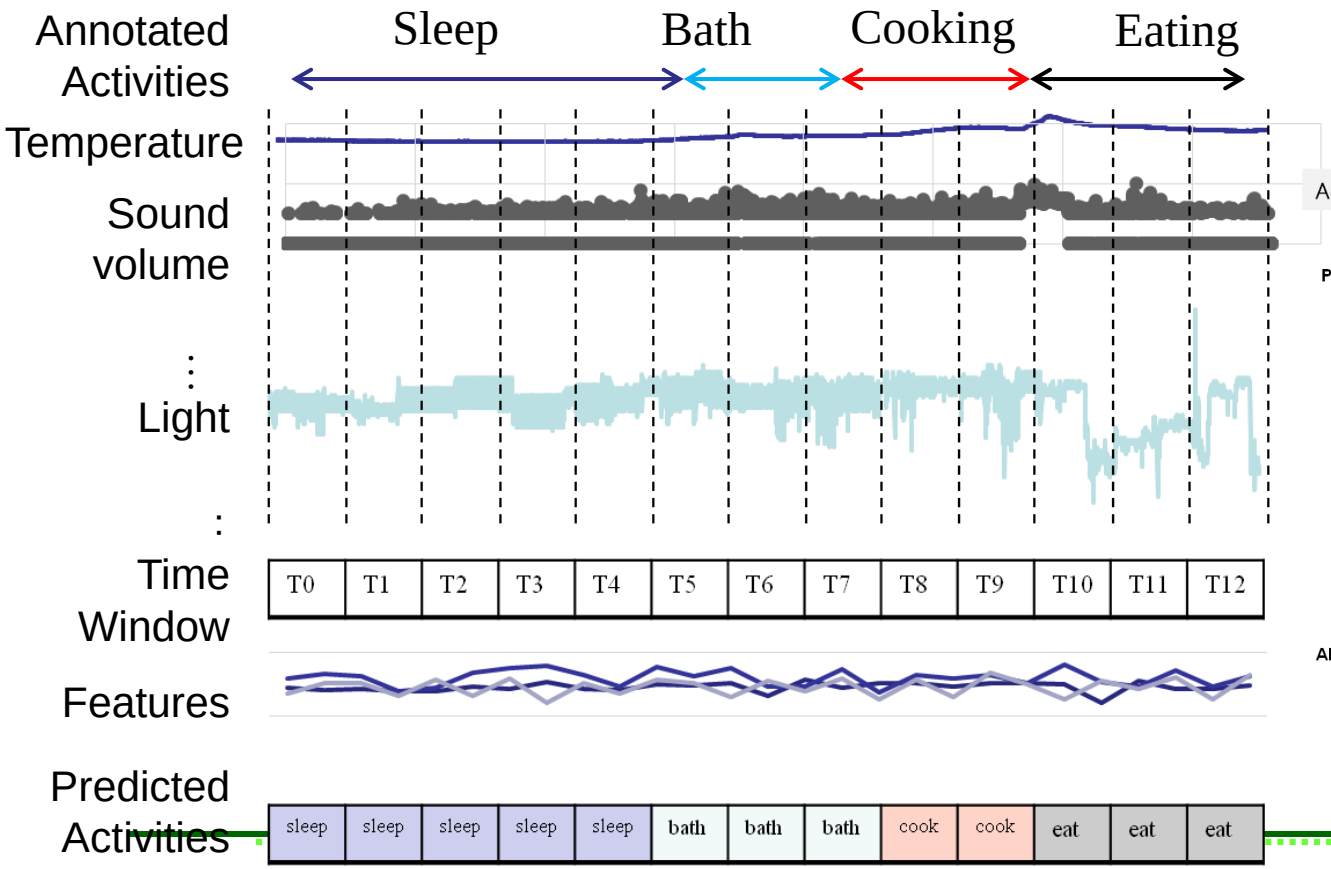


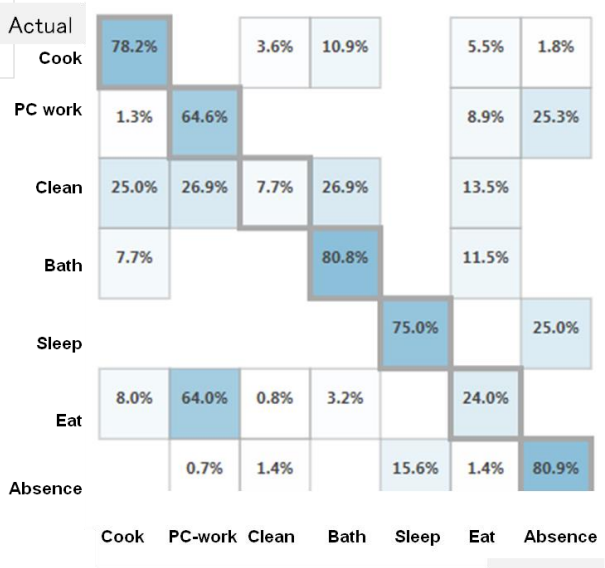
Machine Learning for Recognition Service

- Automatically recognize activities from SensorBox data
  - User annotates activities over time-series data
  - Construct recognition model from annotated data
  - 70-80% accuracy for cook, bath, sleep, absence



LifeLogger App.

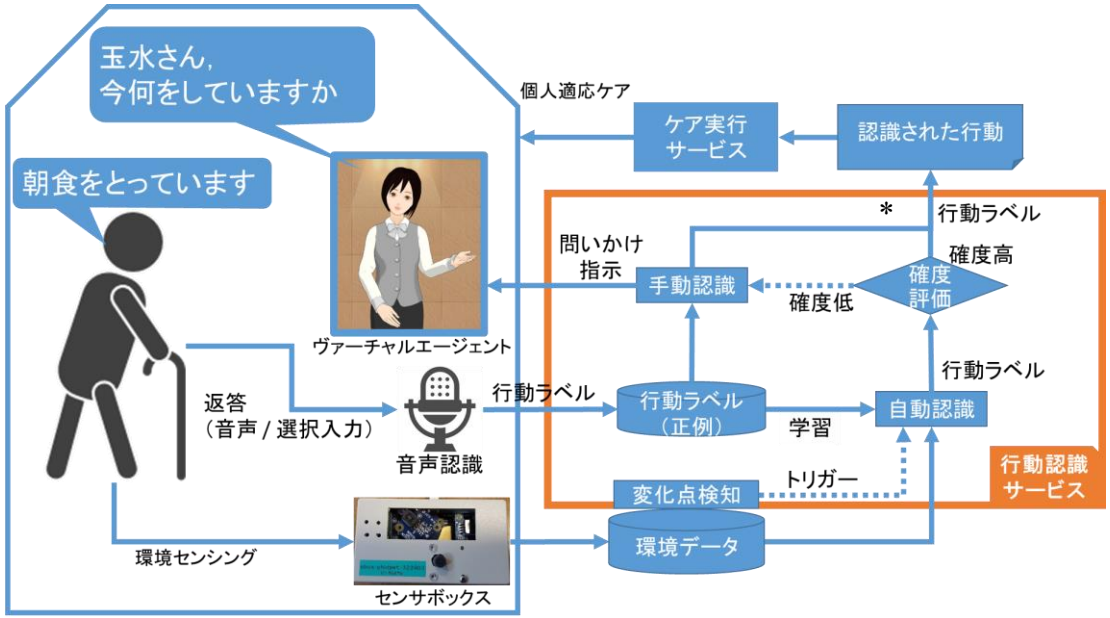




Result with MS-Azure Boosted Decision Forest

Virtual Agent for Agent Service

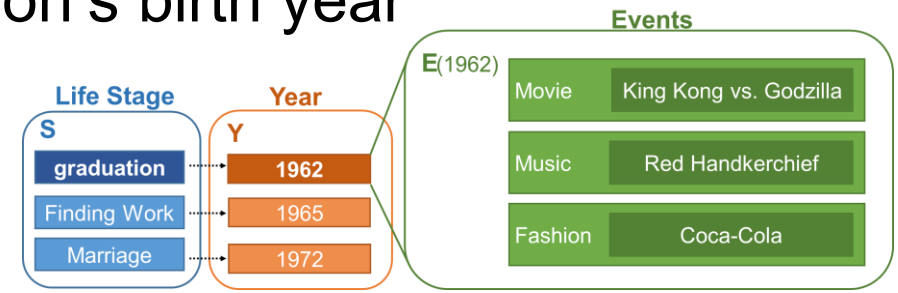
- Provide person-centered communication and monitoring
  - Talk to elderly based on recognized activity
    - Greeting, Reminder, Pictures, Movies
  - Recognize feedback from elderly and record
  - Data annotation through communication
    - Triggered by environment change detection



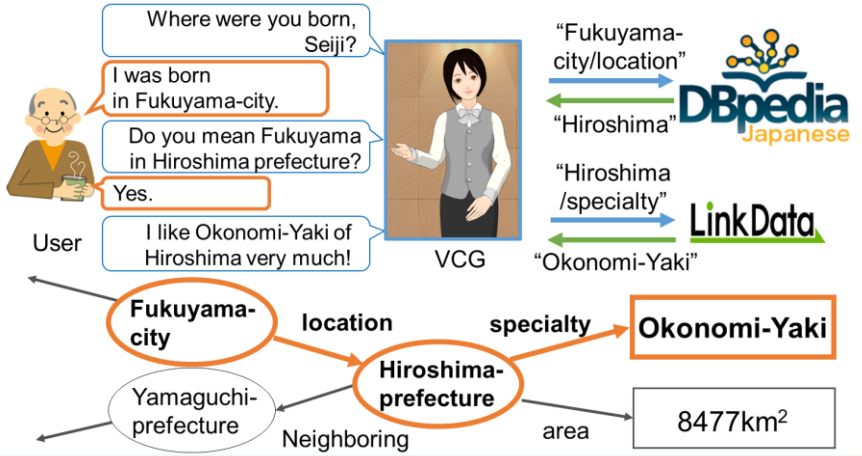
Creating Dialogues for PCC Service

- Dynamically create person-centered dialogues of VA
  - Impossible to write VA's scripts for all possible elderly in advance
  - Through interactions, generate dialogues dynamically from templates

- Generate topics based on person's birth year
  - Identify years of major life stage
  - Look up events and fashions in those years on Web archives
  - Show pictures and movies



- Expand conversation with LOD
  - Traverse linked data for associated topics



Technology and Value

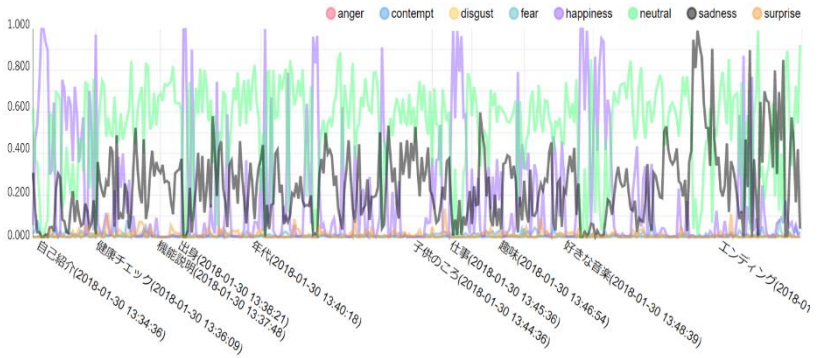
- My concerns from researcher/engineer perspective
  - Precision and reliability of sensor values
  - Accuracy of activity recognition
  - Natural human-like behaviors of Virtual Agent
  - Security and privacy Issues
- Opinions from caregivers and care professionals
  - The fact that IoT is taking care of the elderly is the VALUE
  - Even if it fails to recognize, just ask him. It's communication.
  - Robot is not necessary to be a human being. There must be something that elderly can talk only to robot.
  - Most important is the system really helps. Privacy comes next
- Important for researchers to see real needs and values
  - Especially in CPS/IoT/Smart System fields
  - Cutting-edge technology is not always necessary

Ongoing Research

- Evaluation of Care Quality by Cognitive Computing

Input → Emotion API → output

anger : 0.00001
contempt : 0.00005
disgust : 0.00010
fear : 0.00000
happiness : 0.99386
neutral : 00596
sadness : 0.00000
surprise : 0.00002



- Creating Personalized Virtual Agent by Face Recognition