Implementation of RoIS to robots in ETRI

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Introduction

- **HRI technology** such as human detection and recognition is **very important** for commercialization of an **intelligent service robot**.

- But, the **performance** of HRI technology of commercial robots is relatively **lower than its importance**. **Why?**

What's the problem? (1)

1. Lack of effort in HRI component integration

- Many researches have been **concentrated on the enhancement of each HRI core components.**
  - Person detection, face recognition, and so on.

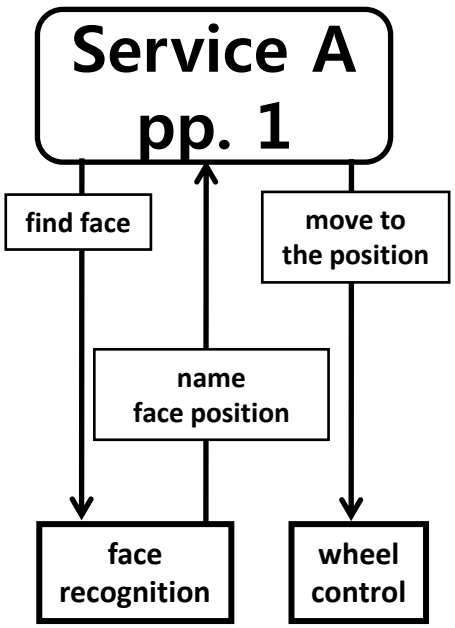
- But, **how to combine unit HRI components effectively** is also **important,** because a HRI service consists of several HRI core components.

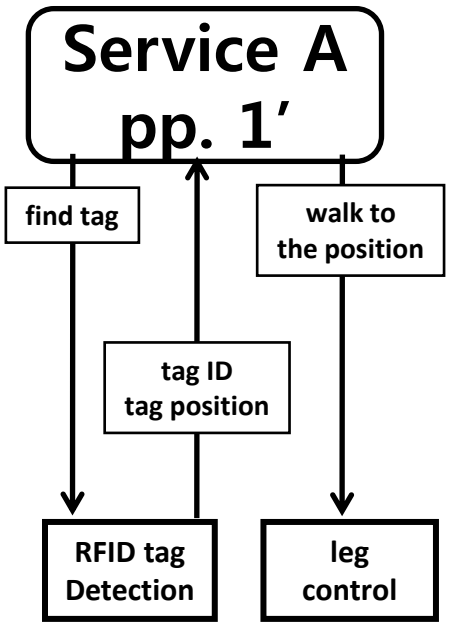
What's the problem? (2)

2. Discontinuity of the recognition processes of HRI components

- **In real life**, **HRI** is bound to **occur continuously**.
- But, **HRI components operate for a short time** of span.
  - Especially when they get requests from an application.

Existing Robotic Service Applications





Application **Layer**

tightly coupled

- Reception
- Guide
- Home security
- Child care
- Elderly care

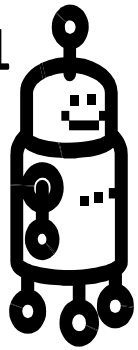
etc.

Function **Layer**

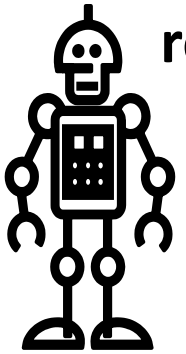
- Human detection
- Face detection and recognition
- Speech recognition
- Human tracking and following
- Sound source localization

etc.

robot 1



robot 2



What's the problem? (3)

3. Difficulty in adapting HRI components to the real robot.

- Current HRI service applications **directly** receive sensor data from the robot and **process the data by using their own HRI components running in them.**

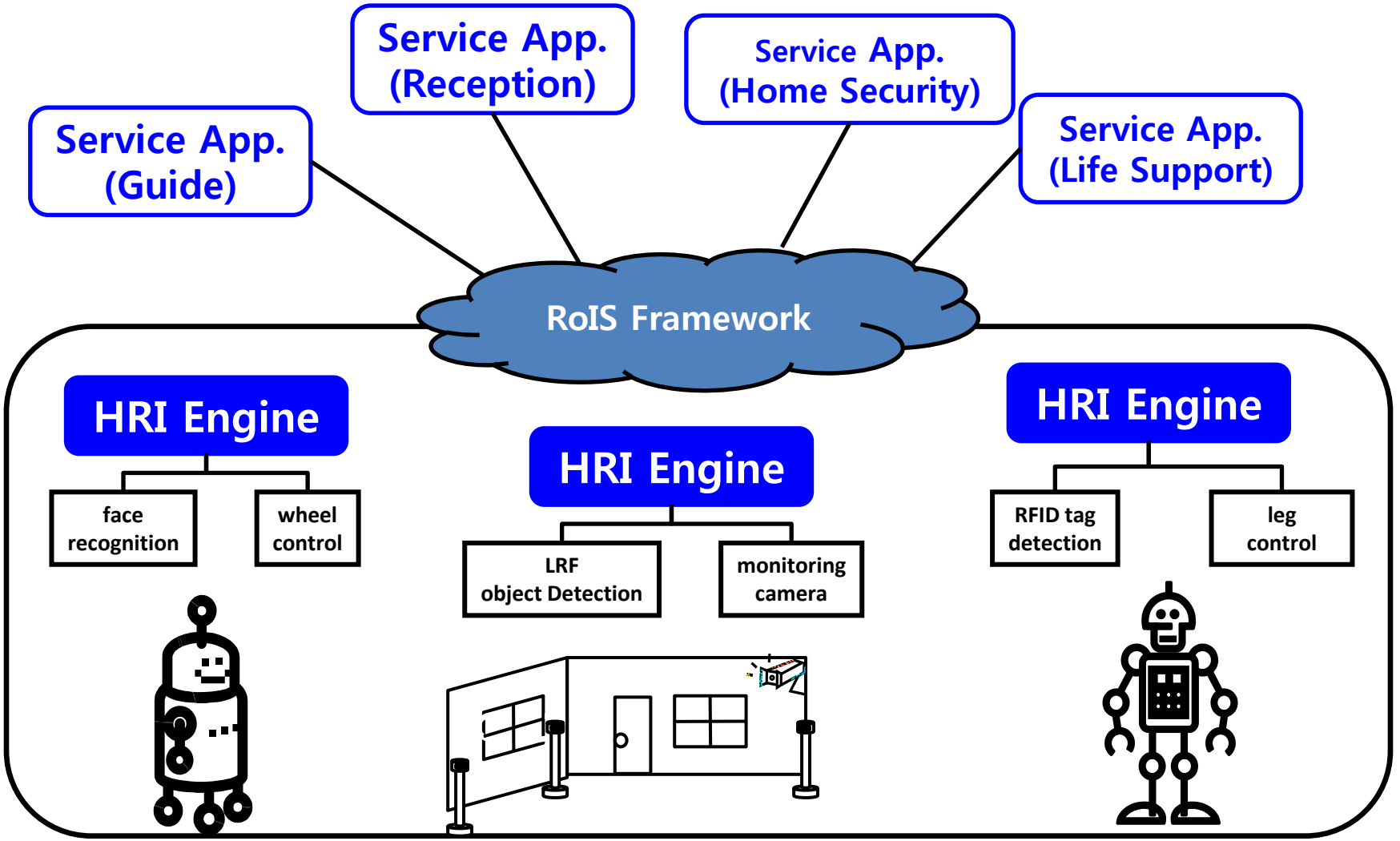
- So, service developers **have burdened** themselves **with works for making the best use of their HRI components.**

The proposed framework: HRIDemon (1)

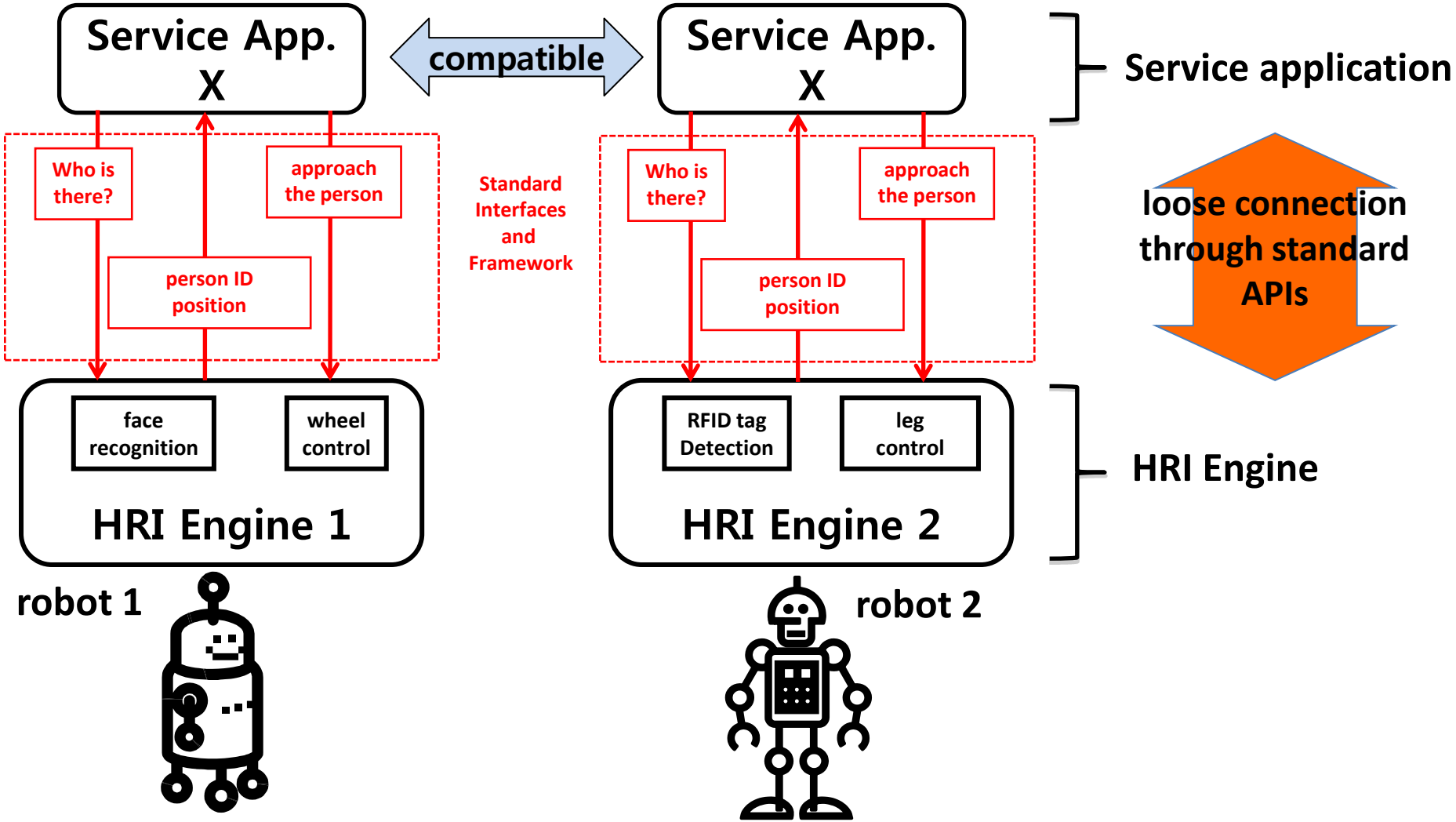
- The HRIDemon is a **HRI component integration framework** for recognizing users' locations, identities and behaviors in human-robot interaction.

- The HRIDemon features **a constant observation of users** for collecting suitable evidences and **fusion of the diverse components.**
  - It ensure more reliable recognition performance and consequently higher quality of HRI services.

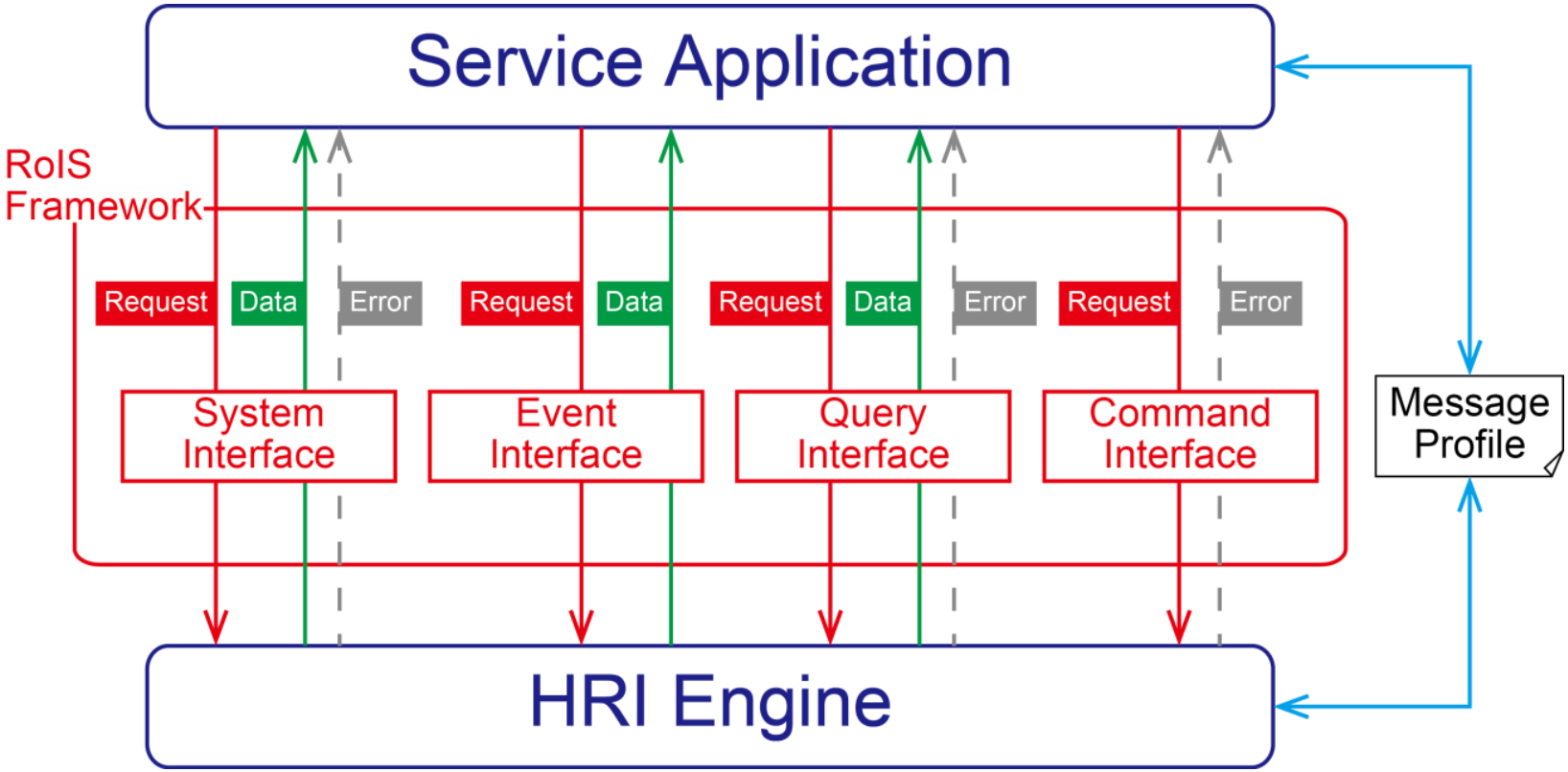
Schematic Picture of RoIS Framework



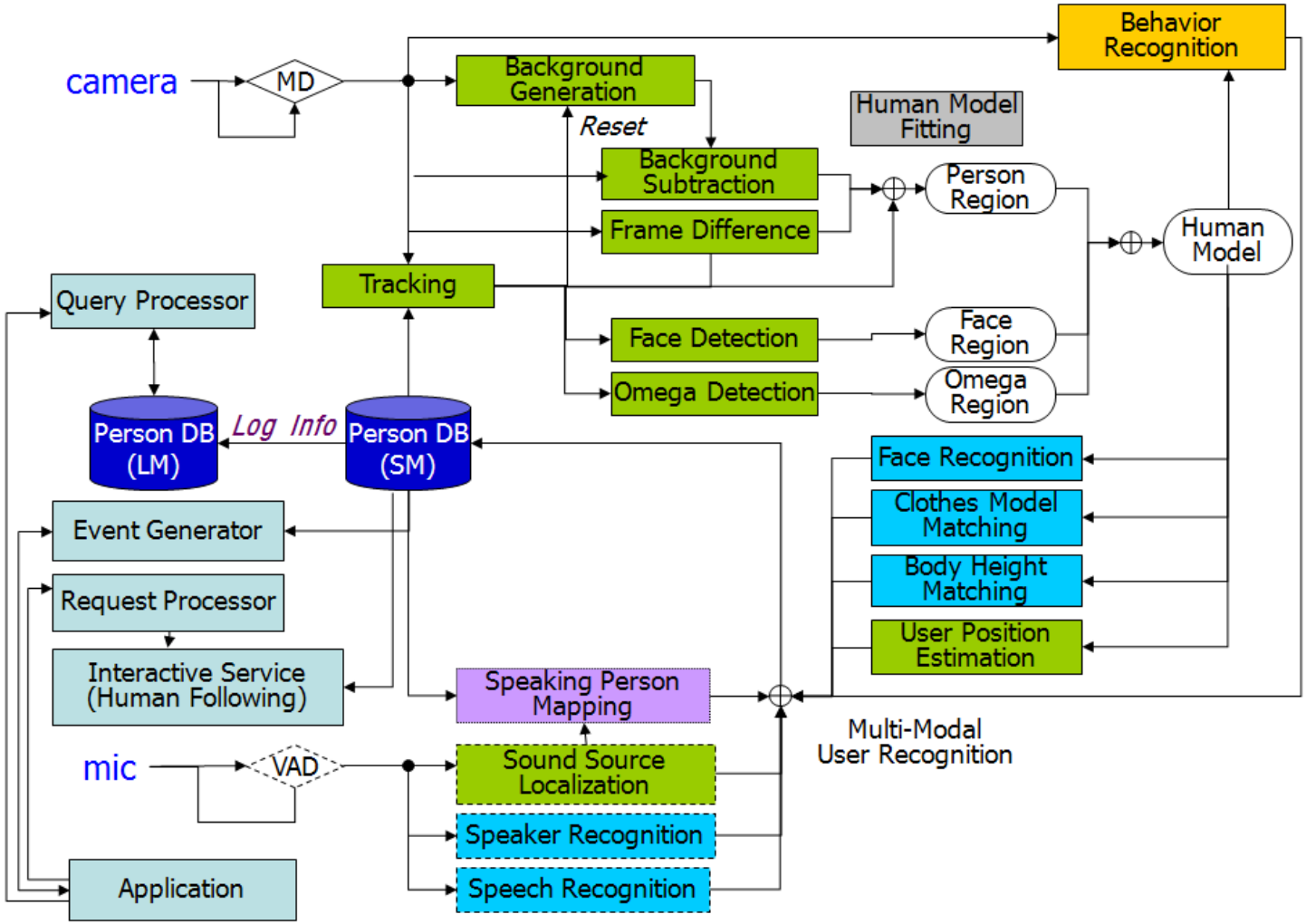
Possible Solution of Software Reuse



Interfaces of RoIS Framework and its message flows



Designed architecture of the HRIDemon in ETRI

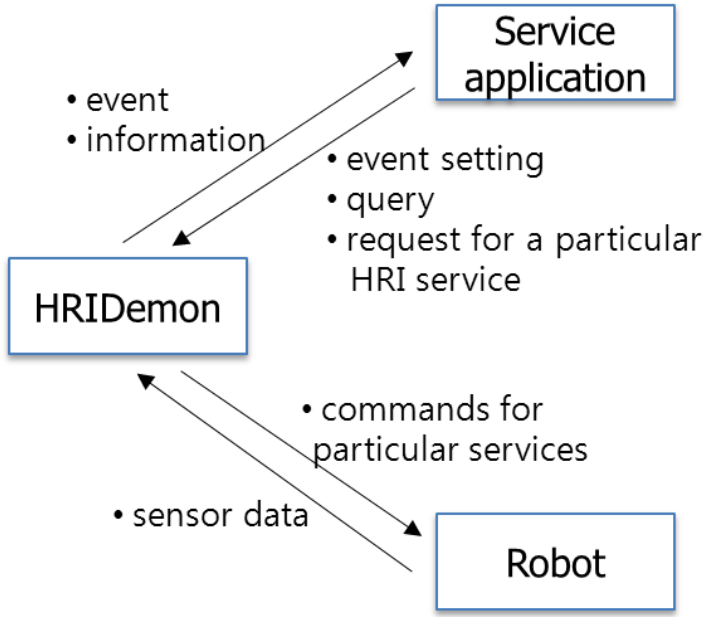


Example of designed architecture of the HRIDemon

The proposed framework: HRIDemon (2)

- The HRIDemon **continuously analyzes sensor data** taken from a robot and **accumulates information about users**.

- When a service application hopes to get some information about users, it can **easily get more reliable information** just by **registering some events** on the HRIDemon.



Event sample

Event Name	Argument
HD_MOTIONDETECTED	PosInfoArray pInfoArray
HD_FACEDETECTED	PosInfoArray pInfoArray
HD_PERSONFOUND	PosInfoArray pInfoArray
HD_GESTURERECOGNIZED	GestureInfoArray gInfoArray
HD_FACEIDENTIFIED	IDInfoArray iInfoArray
HD_PERSONIDENTIFIED	IDInfoArray iInfoArray
HD_SOUNDDETECTED	PosInfo pInfo
HD_SPECIFICSOUNDDETECTED	SoundInfo sdInfo
HD_SPEAKERRECOGNIZED	IDInfo iInfo
HD_SPEECHRECOGNIZED	SpeechInfo spInfo

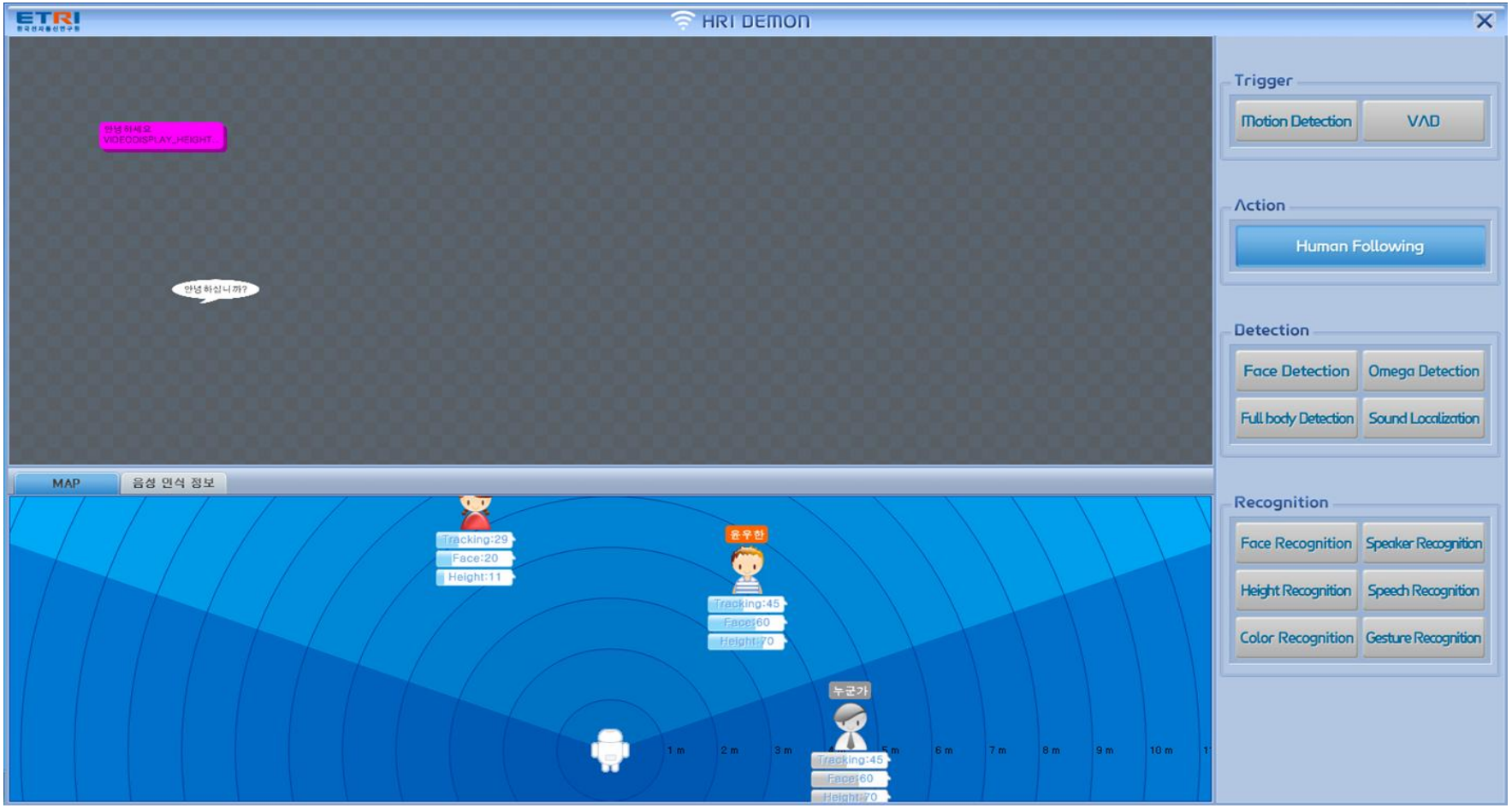
Implementation SCENARIO

Scenario	HRIDemon	ServiceApp
	Start	
Connection		[System:request] Connection to the HRIEngine
	[System:receive] Connection from service application	
	[System:send] Connected	
		[System:receive] Connected
GetUsername		[Query:request] List of registered user names
	[Query:receive] List of registered user names	
	[Query:send] User name list (1) aaa (2) bbb	
		[Query:receive] User name list (1) aaa (2) bbb
SetEvent		[Event:request] Event registration (ID:xxx, name:xxx)
	[Event:receive] Event registration (ID:xxx, name:xxx)	
	[Event:send] Event registration success	
		[Event:receive] Event registration success

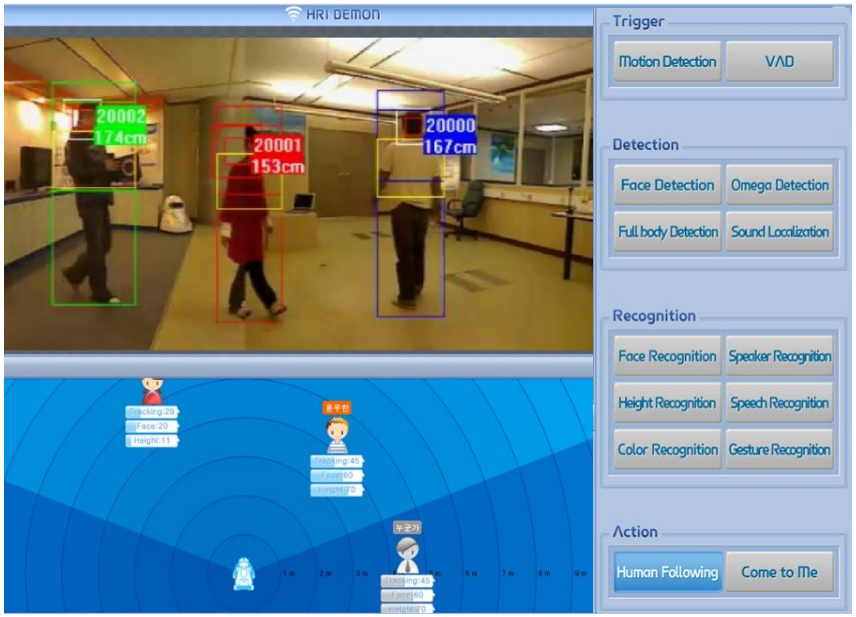
GetEvent List		
	[Query:receive] List of registered events	
	[Query:send] events list (1) id: xx, name: xx (2) id: xx, name: xx	
		[Query:receive] events list (1) id: xx, name: xx (2) id: xx, name: xx (person_identified, gesture_recognized)
actors entered	HRIEngine> motion_detected… HRIEngine> face_detected… HRIEngine> person_detected… HRIEngine> person_identified… HRIEngine> gesture_recognized… scroll…… ……	
Event occurred	[Event occured] person_identified(event_id: %x) 1) person information 2) person information	[EventHandler] person_identified(event_id: %x)

RoIS Event Register

RoIS Engine


ETRI
HRI DEMON
안녕하세요
VIDEODISPLAY_HEIGHT
안녕하십니까?
Trigger
Motion Detection
VAD
Action
Human Following
Detection
Face Detection
Omega Detection
Full body Detection
Sound Localization
Recognition
Face Recognition
Speaker Recognition
Height Recognition
Speech Recognition
Color Recognition
Gesture Recognition
MAP
음성 인식 정보
Tracking:29
Face:20
Height:11
윤우한
Tracking:45
Face:60
Height:70
누군가
Tracking:45
Face:60
Height:70
1 m
2 m
3 m
6 m
7 m
8 m
9 m
10 m

Sample service application



Implemented HRIDemon

Intelligent robot

Conclusions

- **The concept of HRI component integration framework** and a sample design of its architecture were proposed.
- The HRIDemon provides **more reliable recognition results** because it can get **abundant evidences constantly from diverse recognition components**.
- Many developers of HRI service applications **can easily get information on users** from the proposed HRIDemon without concerns about making the best use of individual HRI components.

Thank you!