

FINAL CONFERENCE  
**THE FUTURE OF AGEING**

Embracing Technology for a Fulfilling Life

7th - 8th March 2024 | Évry (South-East Paris) | France | Télécom Sud Paris



EU-JAPAN VIRTUAL COACH FOR SMART AGEING



**DR. KRIISTINA JOKINEN**

National Institute of Advanced  
Industrial Science and  
Technology

CHAIR



**PROF. GIAN-MARCO REVEL**

Università Politecnica  
delle Marche



**DR. GIULIO NAPOLITANO**

Institute for Applied  
Informatics, InfAI



**MARTINO MAGGIO**

Engineering Ingegneria  
Informatica SPA



**4 • How Advanced Technologies Contribute to a Better Ageing Society: artificial intelligence and IoT technology**

# Enabling Trustworthy Interactive Coaching in Smart Living Environments



## Trustworthiness:

Design and develop a virtual coach that can sustain older adults' well-being

## Interaction:

Facilitates older adults' natural communication through conversational coaching strategies in multilingual settings

## Smart living environments:

Integration of various devices and sensors within a platform that supports interoperability, user privacy, standardisation



# e-VITA coach and Advanced Technologies

Prof. Gian Marco Revel

Università Politecnica delle Marche, IT





# e-VITA Virtual Coach



The **e-VITA** virtual coach addresses the **Active and Healthy Ageing** (AHA) domain in terms of cognition, physical activity, mobility, mood, social interaction, leisure, and spirituality, with the aim of empowering **older people in Europe and Japan** to better manage their health and daily activities, resulting in **improved well-being and stakeholder collaboration**.

## Objectives



**PROPOSE** and co-design ICT tools together with end-users and stakeholders to empower older adults to decide how technology should support them in their daily activities.



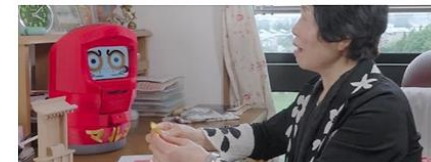
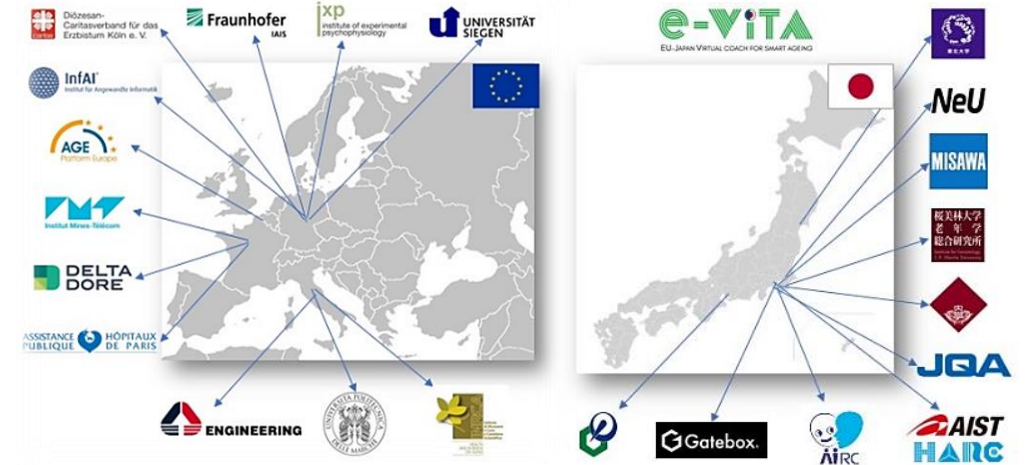
**DEVELOP** an advanced intercultural virtual coach with seamless integration of smart living technologies, advanced Artificial Intelligence and tailored dialogue interaction.



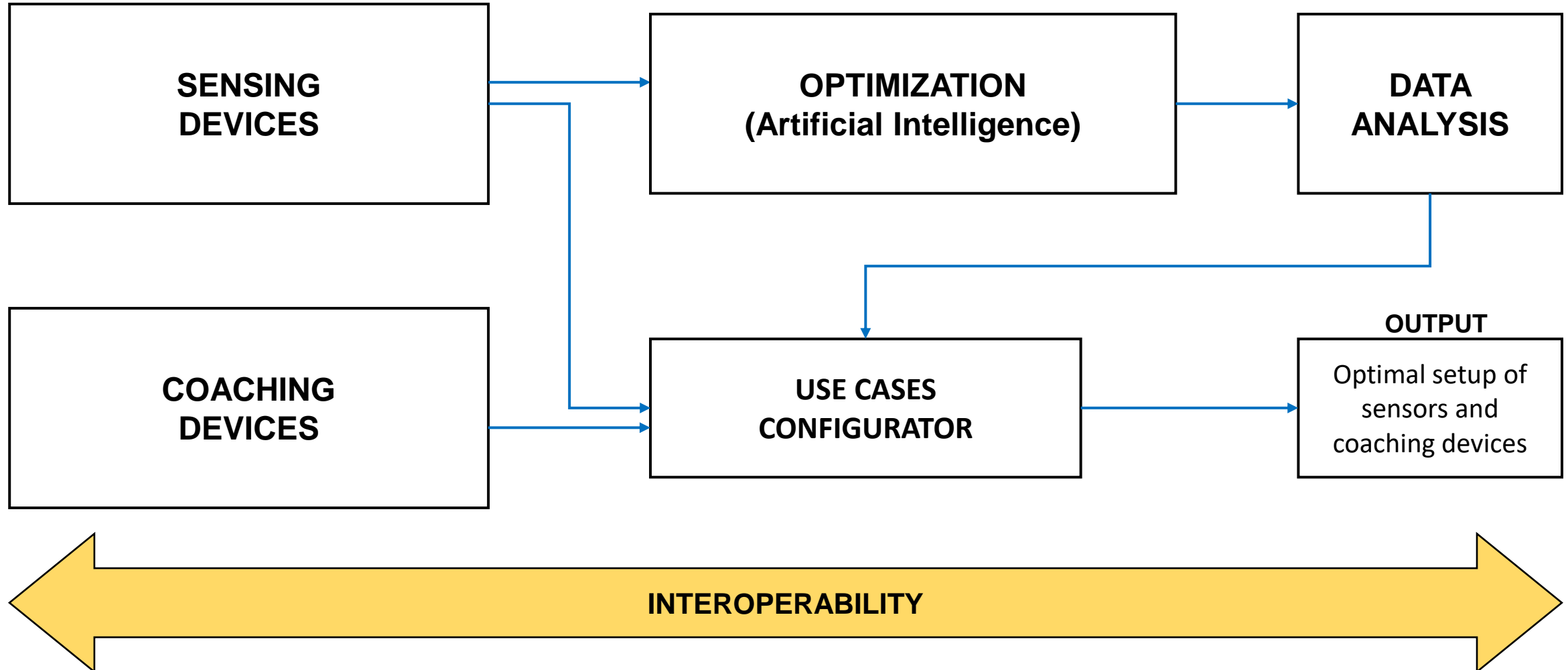
**PROVIDE** a new concept for well-being support and smart health monitoring and companionship for community-dwelling older adults in Europe and Japan.



**INCREASE** the subjective well-being, individual health and social connectedness, and thus improve the quality of daily life of older adults in Europe and Japan.



# Technology at a Glance



# Sensing Devices



## User-related devices

worn by the user to monitor physiological parameters



**Huawei Band 7**  
(HR, HRV, Activity,..)



**NEU XB-01**  
(Brain activity)



**Smart pillow**  
(sleep patterns, movements, breathing patterns)



**OURA Ring**  
(HR, HRV, Temperature, Activity, sleep,..)

## Environmental devices

measure physical quantities useful for assessing the comfort level and Indoor Environmental Quality



**NETATMO Smart Air Quality Monitor**  
(Temperature, Humidity, CO2 level, Sound level)



**EnOcean Air sensor**  
(Temperature, Humidity)

## Home-based devices

monitor user behaviour and activities



**Delta Dore DMB TYXAL+**  
(motion sensor)



**Delta Dore DO TYXAL+**  
(door sensor)



**EnOcean ETC-PIR**  
(motion sensor)

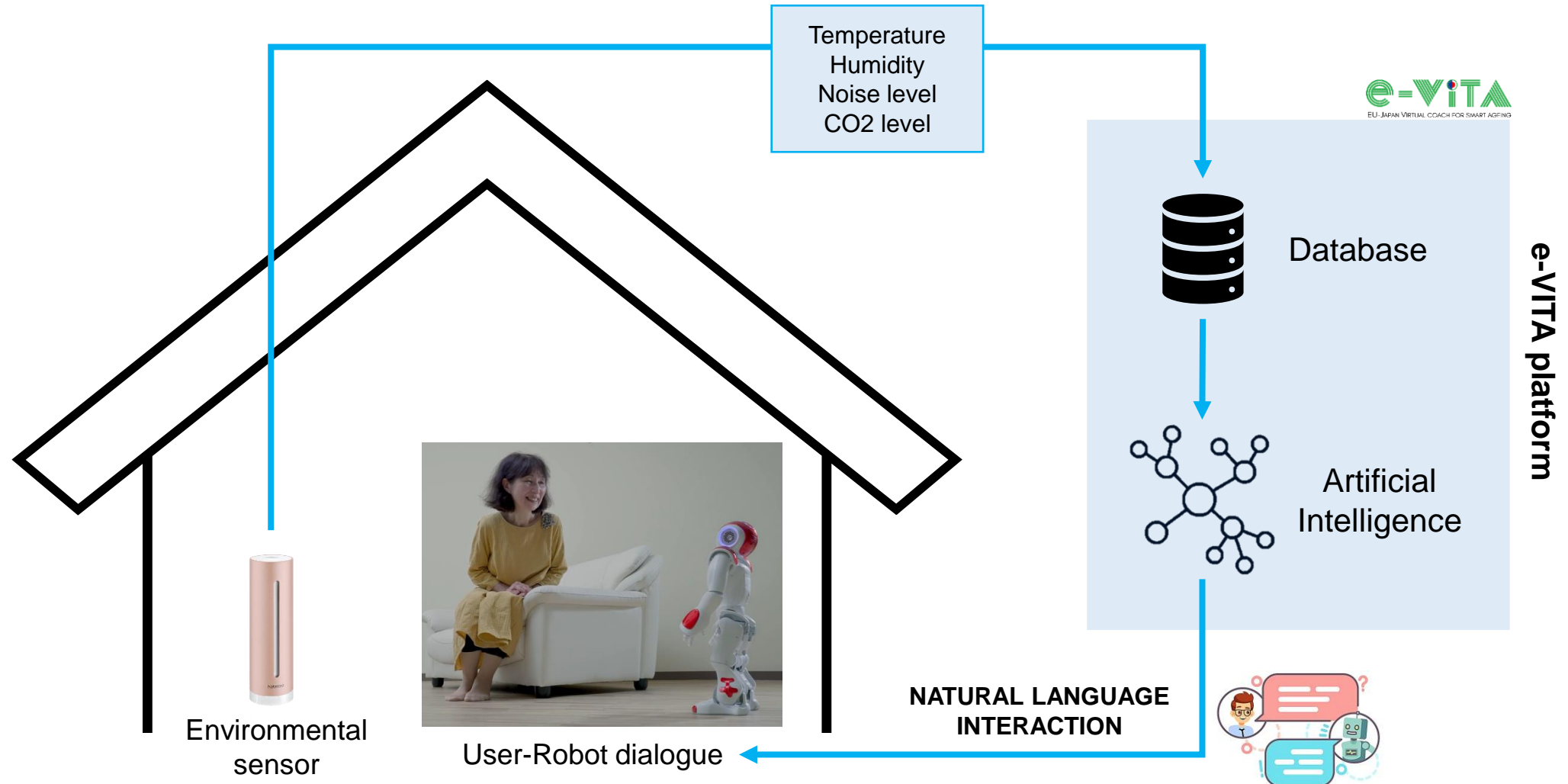


**EnOcean ETB-OCS**  
(door sensor)

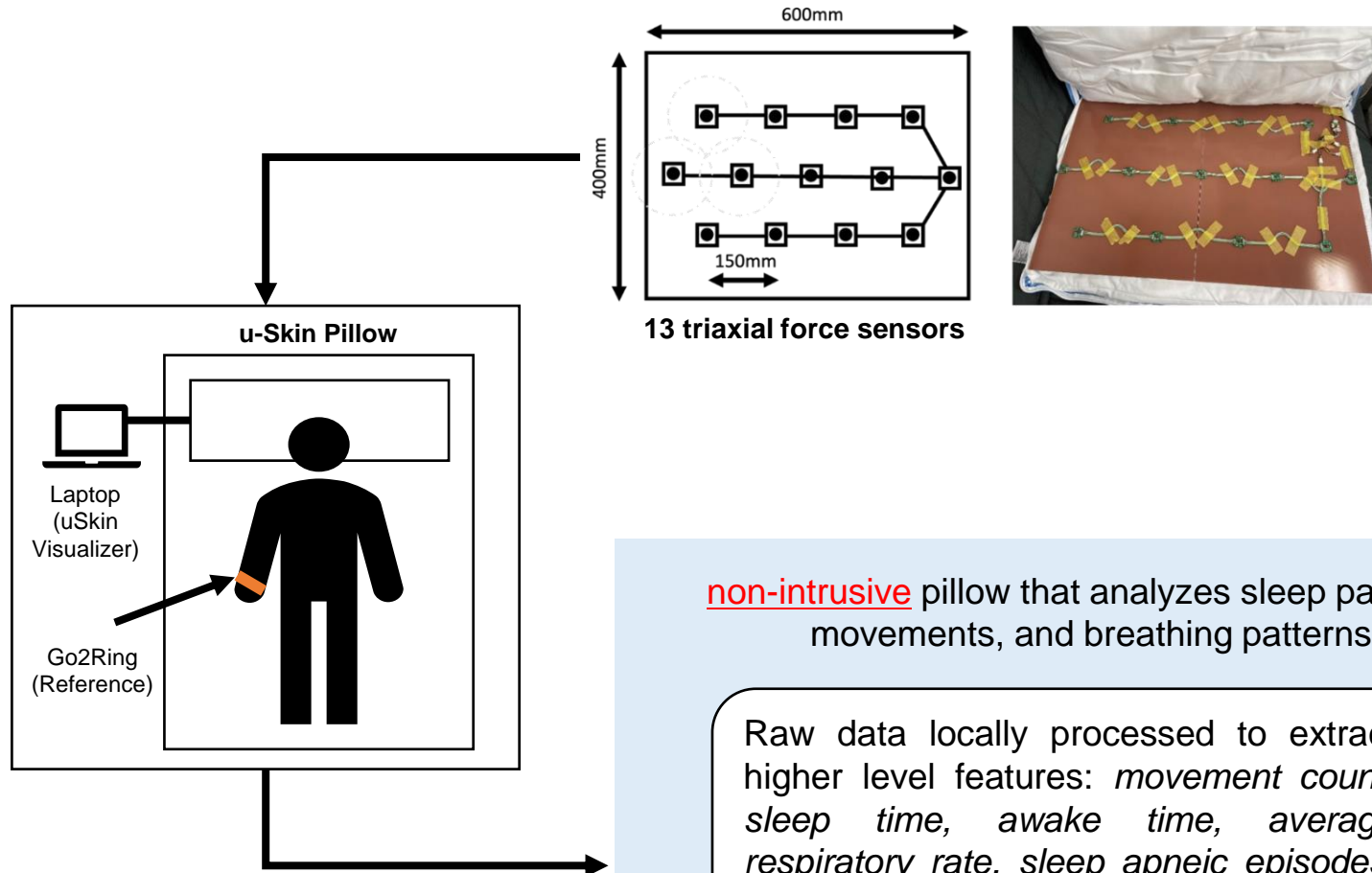
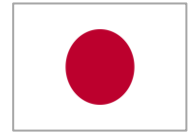
# Human-Coach Interaction



The virtual coach provides **personalized recommendations** based on the analysis of data collected from wearable devices and sensors placed in the smart living environment to improve the quality of life of the older adults.



# “uSKIN” Smart Pillow



**non-intrusive** pillow that analyzes sleep patterns, movements, and breathing patterns

Raw data locally processed to extract higher level features: *movement count, sleep time, awake time, average respiratory rate, sleep apneic episodes, sleep orientation (side, back, front/belly)*



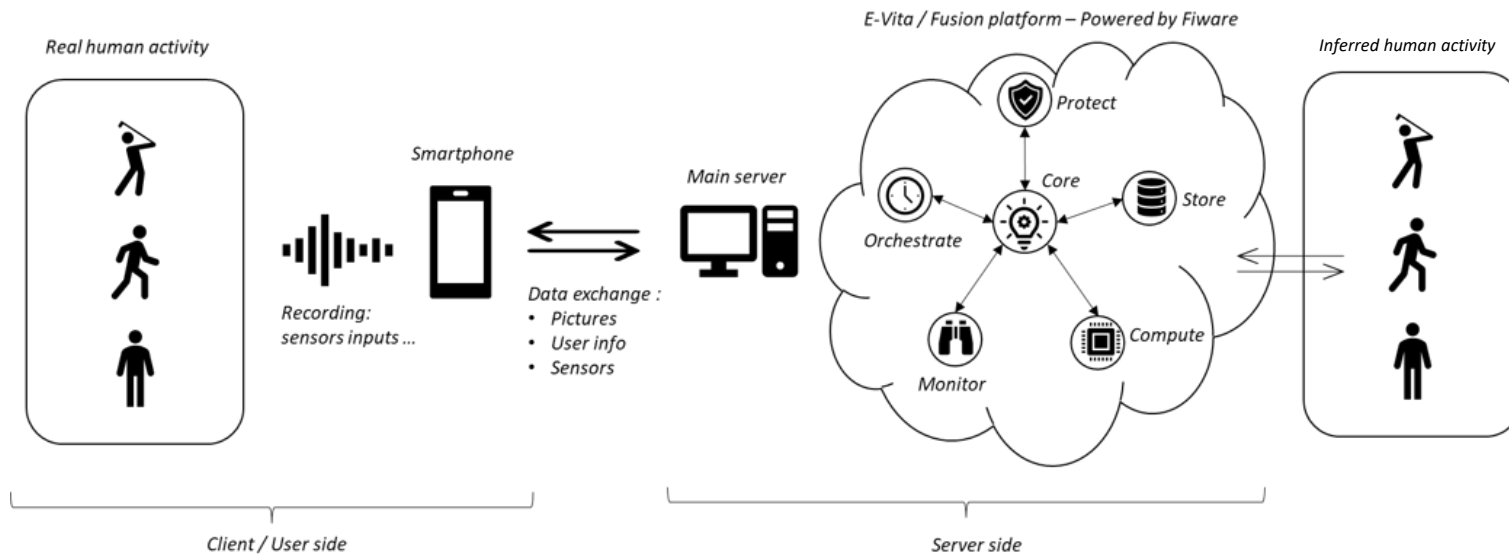


# “MyADL” smartphone APP



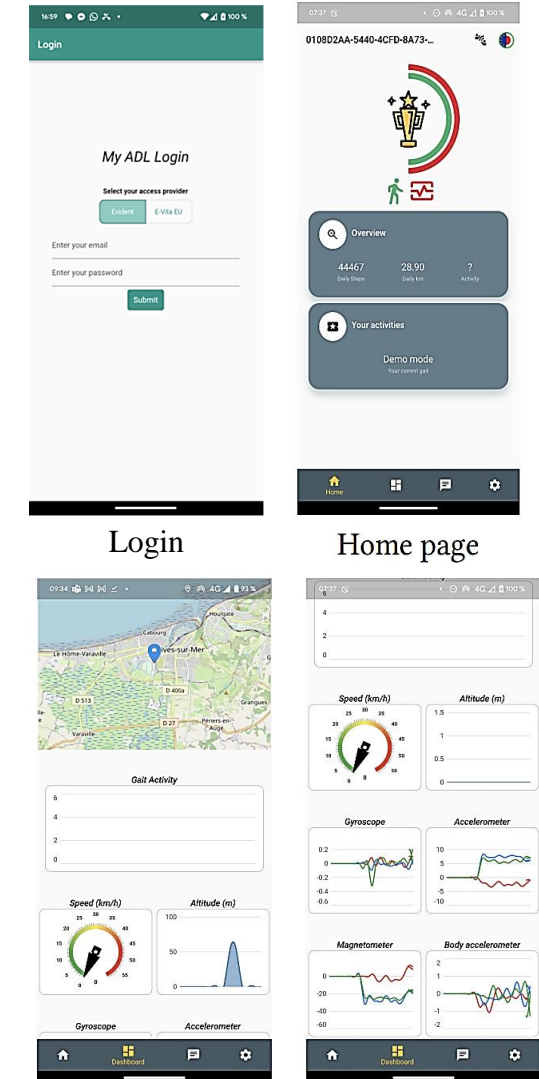
**Mobile application** that allows to determine **users' activity** from data acquired by smartphone sensors (*accelerometer, GPS, gyroscope, etc.*) to accompany them in daily life.

Information about user activity is transmitted, evaluated and displayed to the user.



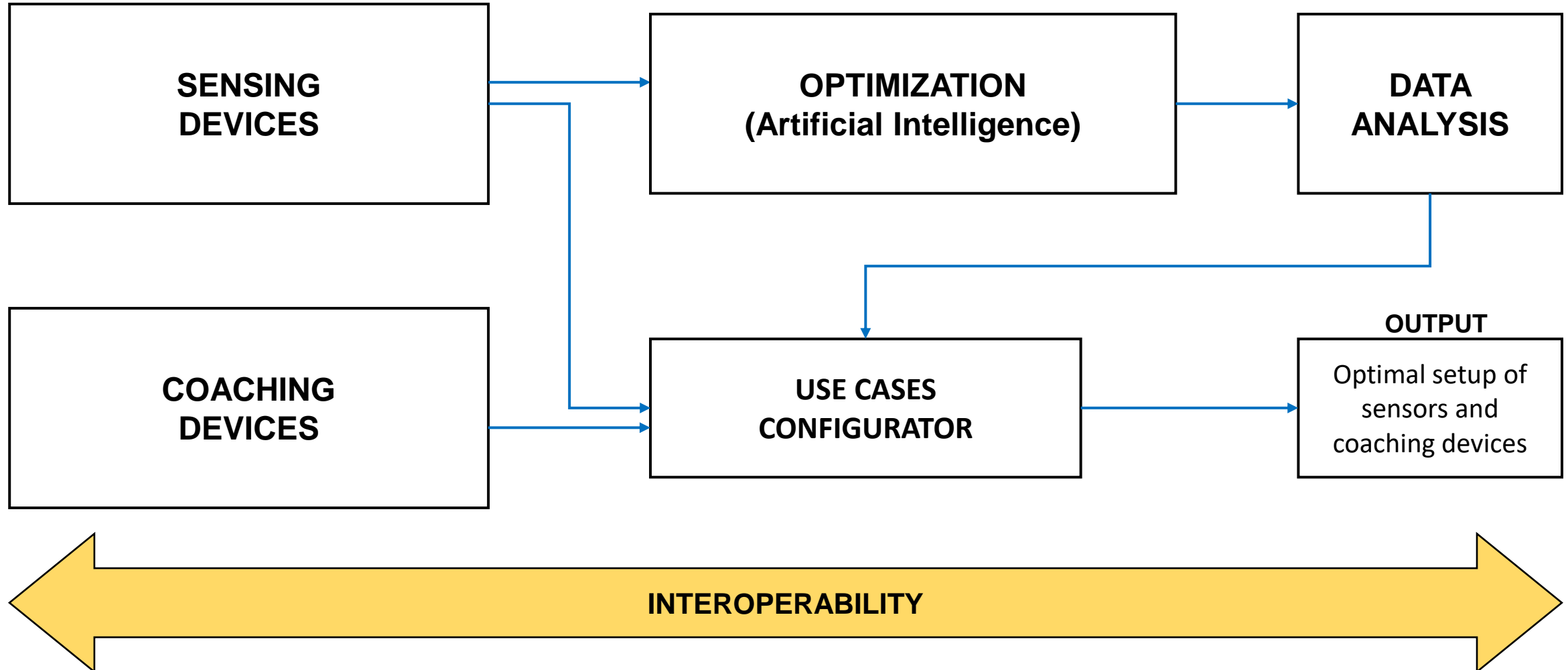
- Smartphone as multi-sensors.**
- Gyroscope
- Developed in Dart with Flutter framework (android + iOS).**
- Future update :**
- Camera (on edge)
  - Microphone
  - GPS
- Streaming capabilities :**
- Accelerometer
  - Magnetometer

- Data fusion platform.**
- Powered by Fiware, Kafka + Redis as additional brokers.**
- Protect your data, Store and access your data, Compute (real time / batch), Monitor data and system, Orchestrate your system.**

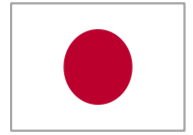


Dashboard

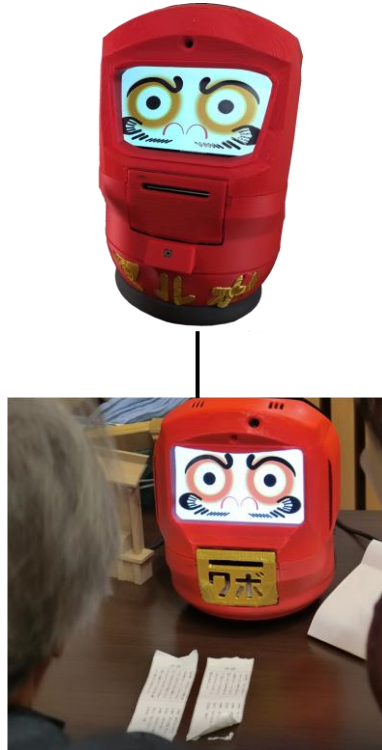
# Technology at a Glance



# Coaching Devices



**Gatebox hologram**  
Provides visualization of a virtual coach with a 3D effect



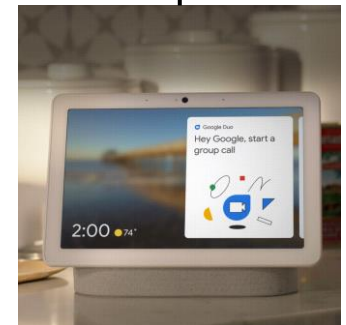
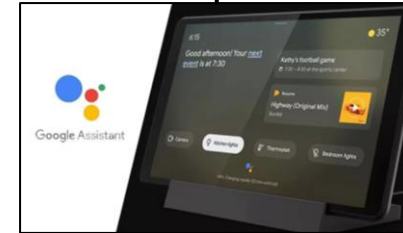
**DarumaTO**  
social robot resembling a traditional Buddhist and Shinto doll called Daruma

**CelesTE**  
interactive small angel statue intended as a prayer companion for Christian Catholic older people

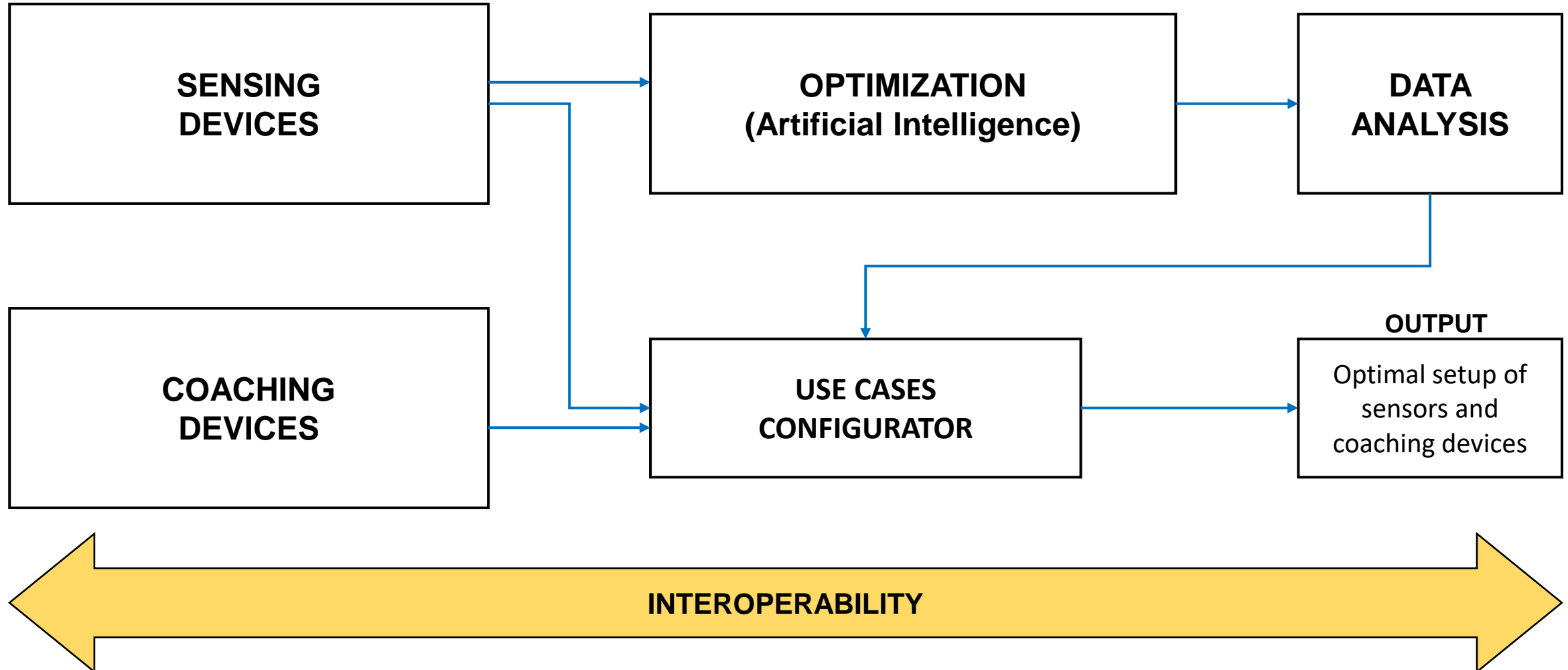


**NAO robot**  
small humanoid robot used for human-robot interaction studies

**Tablet**  
with built-in Google services



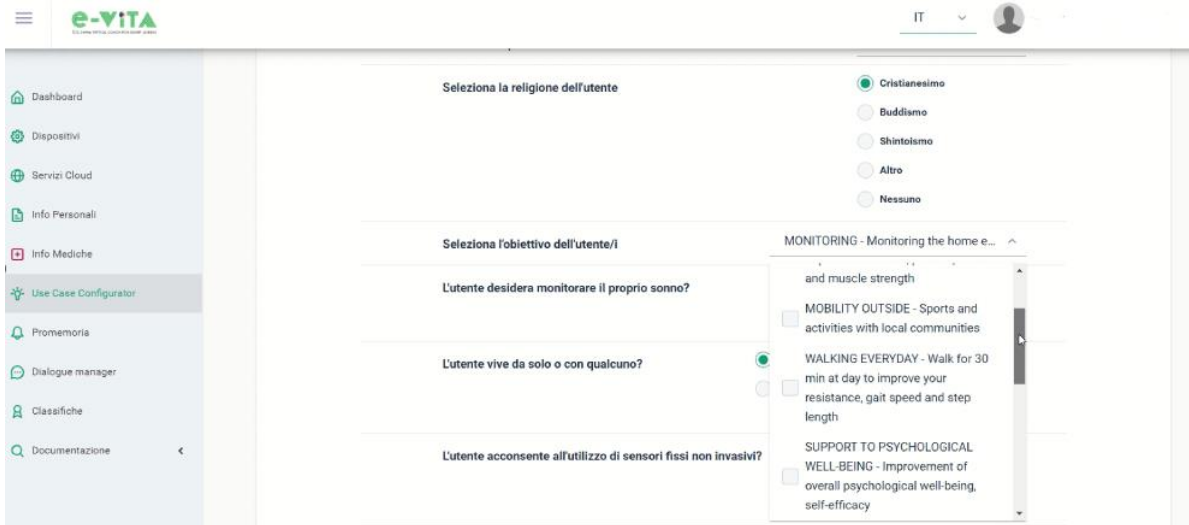
# Technology at a Glance



# Use Cases Configurator

- User-friendly **Graphical User Interface** to meet the needs of platform installers, technicians and caregivers.
- Focusing on creating a **smart living environment** suitable for older people, the tool considers not only their **preferences**, but also the **minimization of costs and the number of sensors without losing measurement accuracy**.
- Optimizing the sensor network **avoids negative feedback** from users in relation to the use of multiple sensors and allows for a **low implementation cost**.

## Integrated into e-VITA Platform

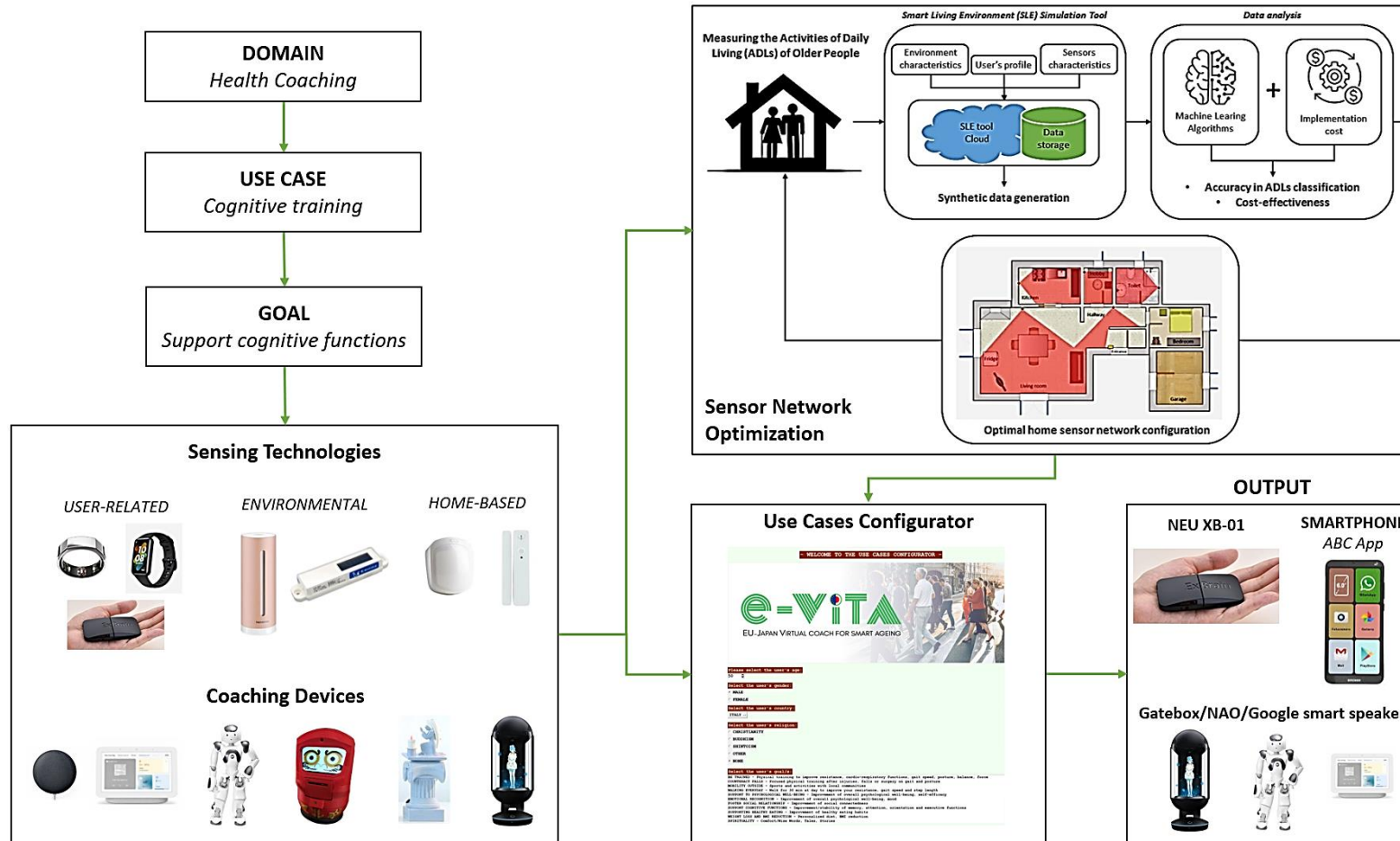


## Stand-alone executable programs for Europe and Japan





# Example of workflow



Example of output for the **Cognitive training** use case related to the Health coaching domain.

## OUTPUT

- **NEU XB-01** (and its ABC App for cognitive training)
- **smartphone** (support device) needed to run the ABC App
- **Gatebox, NAO and Google tablet** as coaching devices (type choice is left to the end users according to their preferences and costs)

# e-VITA Platform Architecture

Dr. Martino Maggio

Engineering Ingegneria Informatica SPA, IT

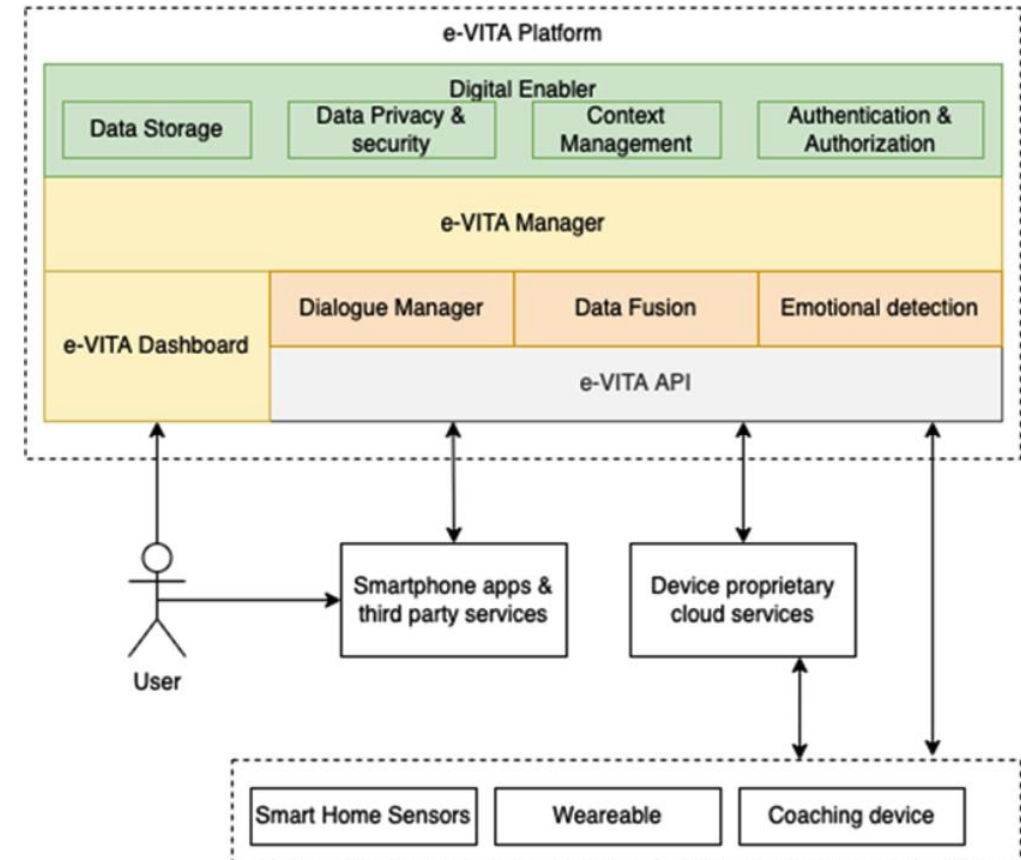


# e-VITA platform



## Main capabilities of e-VITA Platform:

- Connect and integrate the different typologies of devices (sensors, robots, wearable etc) via a set of standard APIs
- Dialogue generation and Data Analysis capabilities, based on the devices' data, provided by specific (AI) modules
- Provide the general capabilities for security and data management.
- Provide Web user interface for the usage and configuration of the platform.

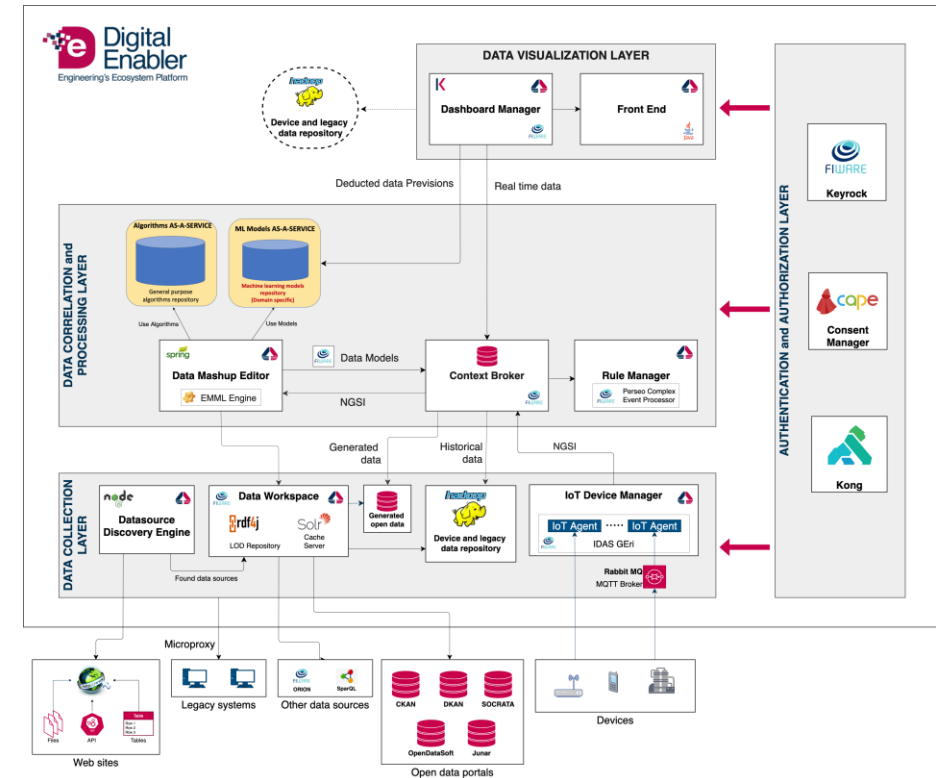


# Digital Enabler and e-VITA



The Digital Enabler (DE) is an Internet of Everything platform, powered by FIWARE, for crawling, collecting, analyzing and rendering scattered data coming from heterogeneous data providers. Moreover, it enables multi-domain data integration, harmonization and multi-device interoperability.

- Digital Enabler is the backbone of the e-VITA platform, providing general capabilities related to device management, security, storage, context management and interoperability
- The e-VITA platform specific capabilities have been developed extending of integrating new modules on top of DE
- e-VITA platform has been deployed in two cloud infrastructures in Europe and Japan



# e-VITA API



The *e-VITA Manager* is the central component of e-VITA platform managing the main communication among the different other element of the architecture and storing the information.

The e-VITA Manager provides different capabilities and interfaces, via REST APIs, to access them. It works as a middleware component to interact with the components of the **Digital Enabler**. There are five sets of APIs exposed by e-VITA Manager:

- **User API** provides access to user information and allows modification or creation of a new user. The API are based on OAuth 2.0 authorization protocol
- **Device API** allows the visualization and management of devices belonging to a user. functionalities to allow devices to send their measurements or files to the platform and provides access to these measurements, stored as historical data within it. The API are based on OAuth 2.0 authorization protocol
- **Service API** provides access and management of the cloud services in which a specific category of devices stores its measurements. The API are based on OAuth 2.0 authorization protocol
- **Researchers API** allows a certain category of users, those who have the role of *researcher*, to obtain the historical data of the devices they need. The API are based on OAuth 2.0 authorization protocol
- **Clients API** allows access to the e-VITA services to third-party applications, which are authorized to access them. The API are based on OAuth 2.0 authorization protocol

The screenshot displays the 'Evita Manager API' documentation page. At the top, it shows the API version as 'v2 OAS3' and a link to '/api/v3/api-docs'. Below this, there is a 'Servers' section with a dropdown menu showing the URL 'https://manager.evita.digital-enabler.eng.it/api - Generated server url' and an 'Authorize' button. The main content area is titled 'user-controller' and lists several REST API endpoints:

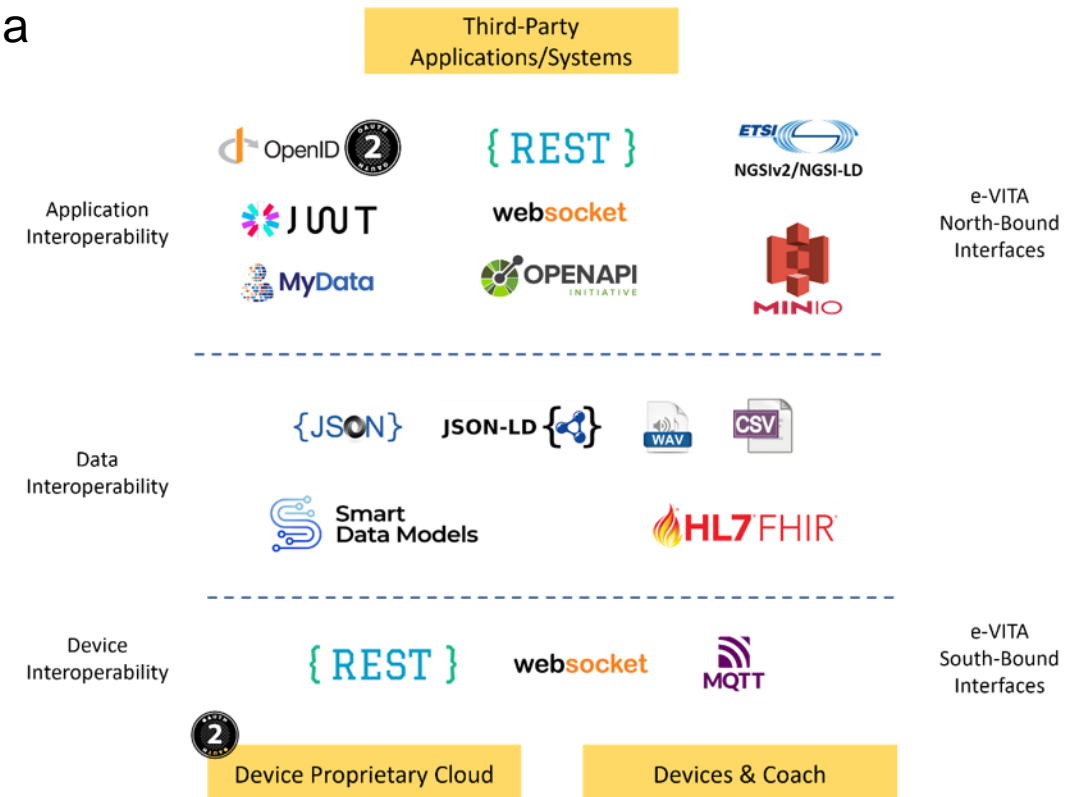
- GET /user**: Get logged user information
- PUT /user**: Update logged user information
- POST /user**: Create a new user adding his personal information
- DELETE /user**: Remove logged user
- GET /user/userManagement**: Get all registered users managed by the logged user (for human\_coach, care\_giver or study\_center)
- GET /user/userManagement/{id}**: Get all information regarding the managed user
- GET /user/emotions**: Get, if any, the emotions related to all the audio files previously sent from the logged user's devices



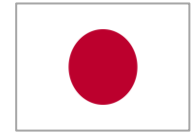
# Interoperability in e-VITA



- An important aspect of the e-VITA solution is the integration of heterogenous devices, data, and software components in a coherent platform.
- The interoperability plays a key role in e-VITA platform and can be identified in three main categories:
  - interoperability related to devices and their interconnection,
  - interoperability related to data formats and semantics,
  - interoperability related to data and functionalities access from external systems and applications.
- The interoperability is achieved by the adoption of open a wide used international standards and technologies



# e-VITA devices



- Devices (i.e. wearable, sensors and coaching devices), can be connected in e-VITA in two ways
  - the device sends/receive data using the e-VITA rest API. Data can include multiple information such as measurements or user dialog messages
  - the device sends data to a third-party proprietary cloud and the e-VITA platform collects data from the cloud using proprietary rest API. This scenario is mainly related to wearable and IoT devices of external vendors
- e-VITA platform supports different device brands and new connector can developed to support further devices



Register a new device

1 Device Category      2 Device Type      3 Device Info

Select the specific category of device you want to register from among those available and enter your choice.

- NETATMO**  
Netatmo Smart Home devices      Please, login to the cloud service first!
- NEU**  
NEU Wearable devices      Please, login to the cloud service first!
- OURA RING**  
Oura Ring Wearable devices      Please, login to the cloud service first!
- HUAWEI**  
Huawei Wearable devices      **SELECT**
- EN OCEAN**  
EnOcean Smart Home devices      **SELECT**
- DELTA DORE SENSORS**  
Delta dore sensors Smart Home devices      **SELECT**
- COACHING DEVICES**  
Coaching Devices Robots      **SELECT**

# e-VITA dashboard



- e-VITA dashboard is the web user interface that allows users to manage and configure the e-VITA capabilities. In particular it allows to:
  - Connect devices and access to historical device data
  - Use Dialogue manager to chat with the e-vita coaching system
  - Configure rules and reminders for proactive dialogues
- Manage personal information and preferences
- Manage privacy settings and data access consents for the different e-VITA related services
- Access to use case configurator
- Manage platform configuration and security (only admin users)
- e-VITA dashboard is also accessible by mobile devices allowing people to access e-VITA in mobility

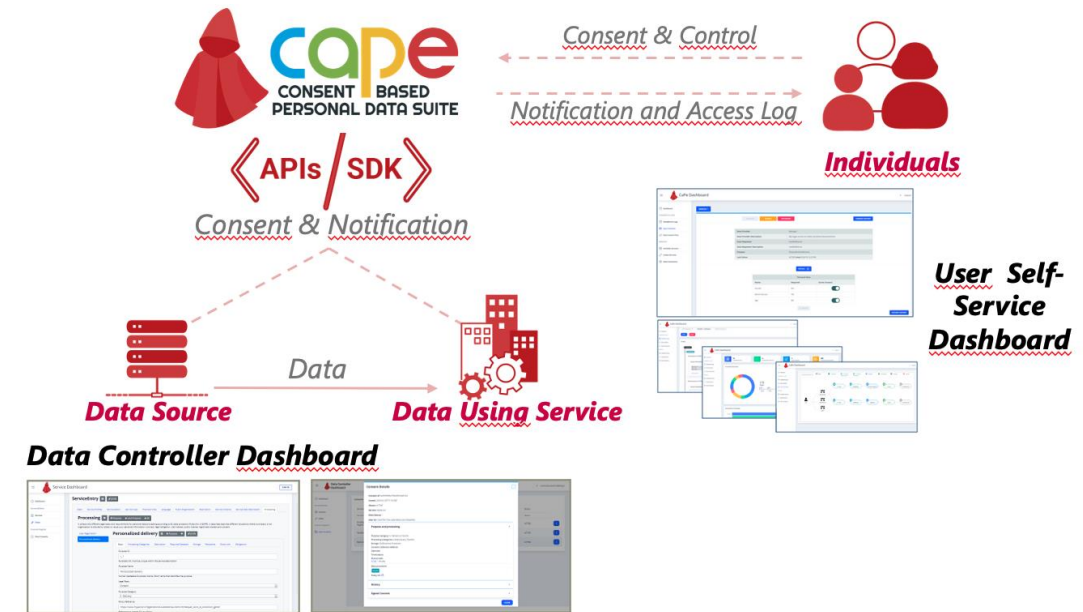
The image displays three overlapping screenshots of the e-VITA dashboard. The top screenshot shows the 'Devices' management page with a grid of device cards, each with a name, type, and a toggle switch. The middle screenshot shows the 'Dialogue Manager' chat interface with a conversation history and a text input field. The bottom screenshot shows the 'Leaderboard' page with a table of users and their step counts.

	DAILY	WEEKLY	TOTAL	STUDY CENTERS	COUNTRIES	EU VS. JP
<b>Users Competition</b>						
<b>List of best Users of the Day</b>						
8	Marinella	EU	IT	ANCONA	3813 steps	2850
9	Pierluigi	EU	IT	ANCONA	2645 steps	1624
10	Romella	EU	IT	ANCONA	1643 steps	1035
11	Maria Gabriella	EU	IT	ANCONA	990 steps	592
12	Caritas16	EU	DE	COLOGNE	333 steps	237
13	francescadag	EU	IT	ANCONA	275 steps	188
14	test_forRoles	EU	IT	TOKYO	275 steps	188
15	User	EU	IT	ANCONA	275 steps	188
16	BrocaTest	EU	FR	PARIS	0 steps	Not Available

# e-VITA privacy management



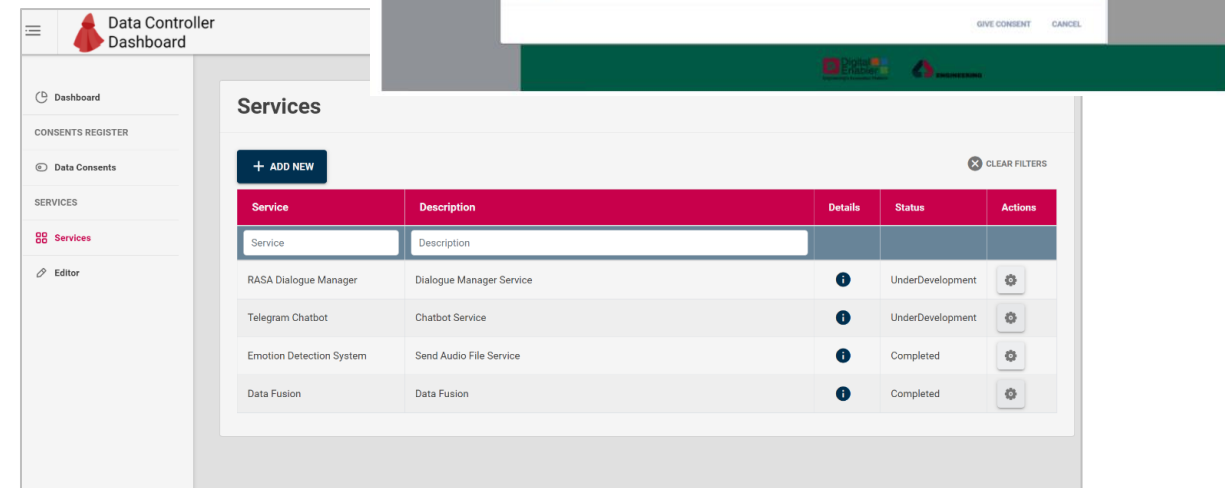
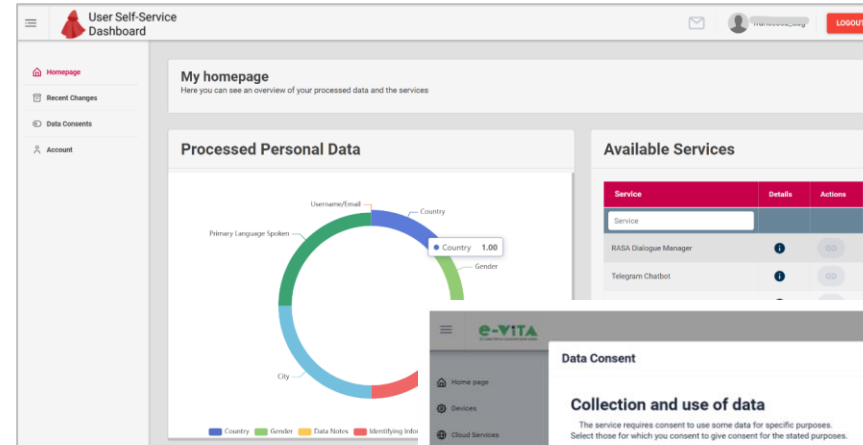
- CaPe is a consent-based and user-centric open source platform targeted at organizations acting as Data Processors, in the private or public sector.
- CaPe is the solution **adopted in e-VITA to manage personal data privacy in the use of Coaching System digital services**
- CaPe acts as a mediator between the data provider (the e-VITA platform itself that collects personal data, wearable sensor data etc) and the services that needs to use this data for a specific purpose (e.g. emotion detection, dialogue manager etc)
- Each service that deals with user's personal data has to be previously described by the Service Provider and registered in CaPe. The process of service description allows to define the data that is processed and, also, its purposes with reference to specific privacy statements.
- The user, before the service usage, has to provide his/her consent to grant access to specific set of data for specific purposes.



# e-VITA privacy dashboard



- The privacy dashboard allows the final user to provide and manage the consent to the services.
- The privacy dashboard was designed taking in consideration requirements from older adults involved in e-VITA.
- Specifically, the privacy dashboard:
  - Provides users an overview of collected data and specifies the purpose of collection. It enables older people to give informed consent and be aware of the data collection.
  - Enables end users to choose and track which data is being collected and control the data flow (e.g., withdraw consent)





# e-VITA Dialogue Modelling

Dr. Giulio Napolitano

InfAI, DE

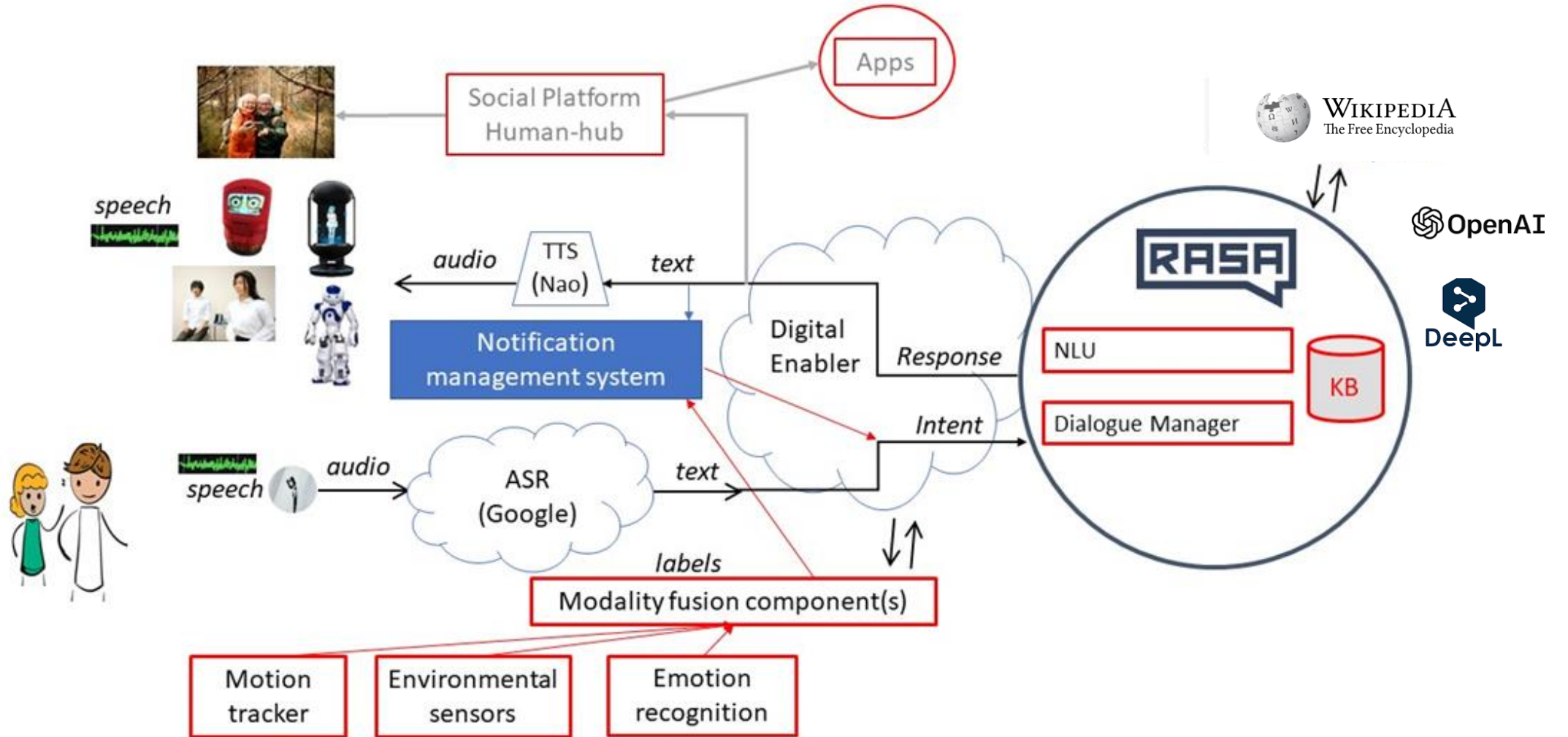
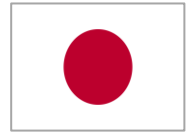


# Dialogue system - Overview



- Functionalities
  - *Motivational health coaching*, several domains: safety, nutrition, exercise, psychological, prevention, vitality, cognitive, social
  - *Services*: information from Wikipedia, news and weather services
- Scripted approach
  - NLU + stories
- LLM approaches
  - *RAG technique*: LLM restricted to documents
  - *Generalised LLM*: prompt engineering

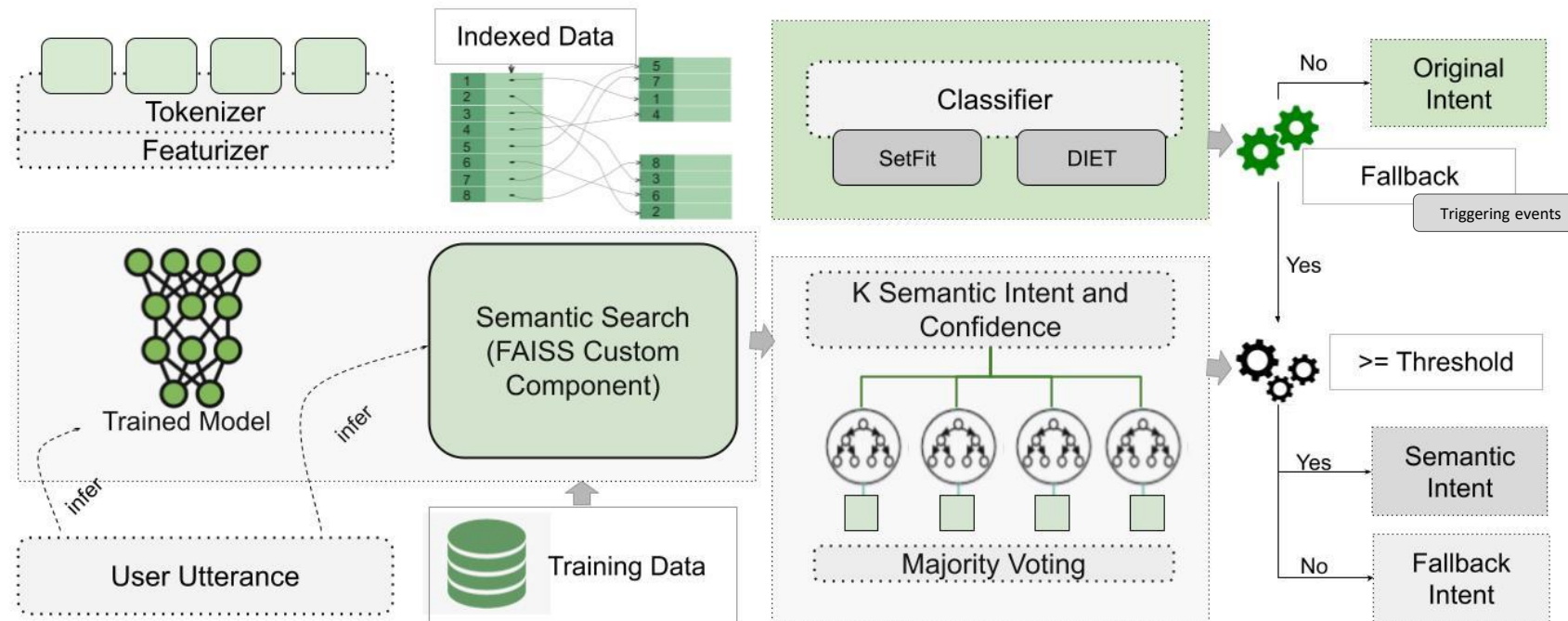
# Main components



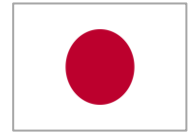
# NLU with stories



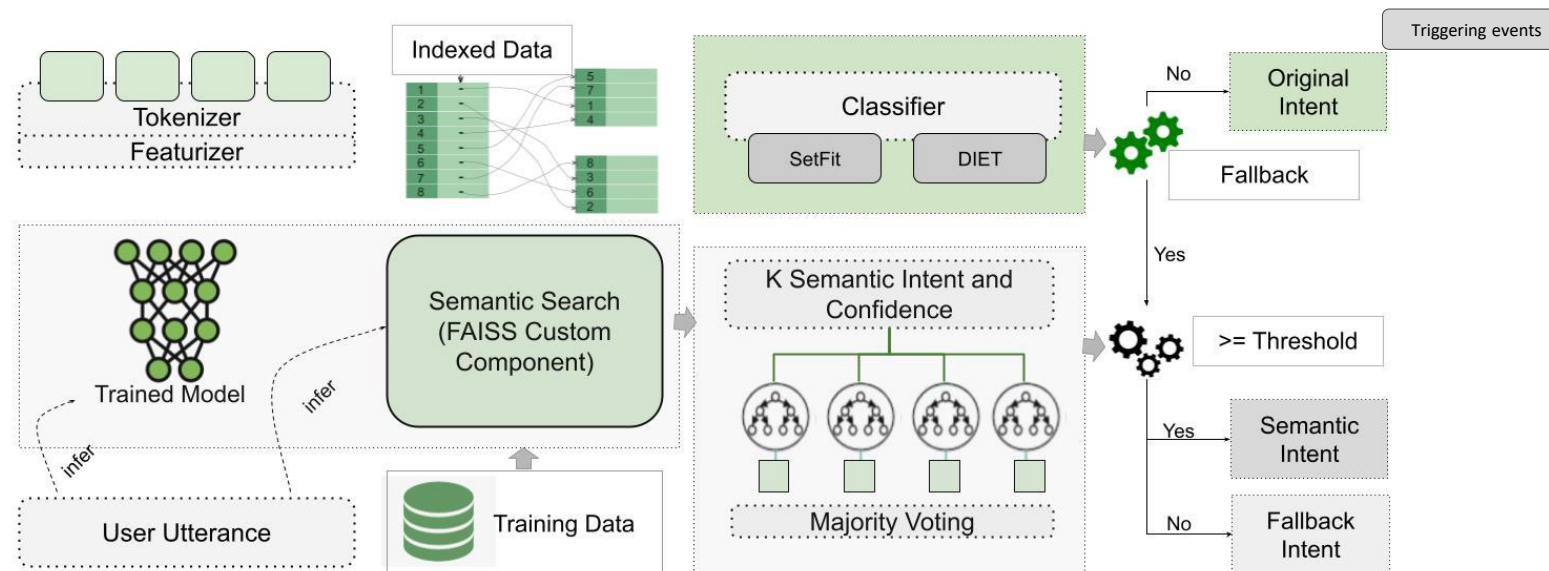
- User utterances are classified and, where possible, the relevant story is triggered
- Events are triggered simulating specific utterances



# Story example

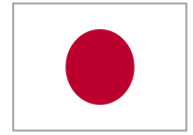


story	lighting conditions							
intent	request_lighting_condition_practices	User	"I am worried about the lighting conditions inside my home, could you tell me what are the best practices for lighting for older adults?"	I am concerned about the illumination levels inside my house, could you inform me what are the best guidelines for lighting for seniors?	I am anxious about the brightness quality inside my home, could you explain to me what are the best standards for lighting for older people?	I am nervous about the light intensity inside my house, could you advise me what are the best tips for lighting for elderly adults?	I am troubled by the lighting situation inside my home, could you teach me what are the best methods for lighting for senior citizens?	I am uneasy about the light exposure inside my house, could you show me what are the best practices for lighting for older adults?
action	action_suggest_proper_lighting	Robot	"Absolutely. Good lighting is important for older adults to see clearly and avoid falls. Here are a few things you can do to improve the lighting in your home: 1. Use warm white light bulbs (2700K-3000K). 2. Avoid bright overhead lights. 3. Use task lighting for reading or other activities. 4. Consider dimmer switches to adjust light levels. 5. Place nightlights in hallways and bedrooms. 6. Regularly check and replace light bulbs. 7. Use natural light when possible."					
intent	satisfied_from_bot_answer	User	"That's helpful, thank you. This is helpful, thank you. That's useful, thank you. That's informative, thank you. That's beneficial, thank you. That's valuable, thank you."					
action	action_ask_again	Robot	"You're welcome. If you have any other questions or concerns about indoor lighting or any other topic related to indoor safety for older adults, please let me know. I'm here to help!"					

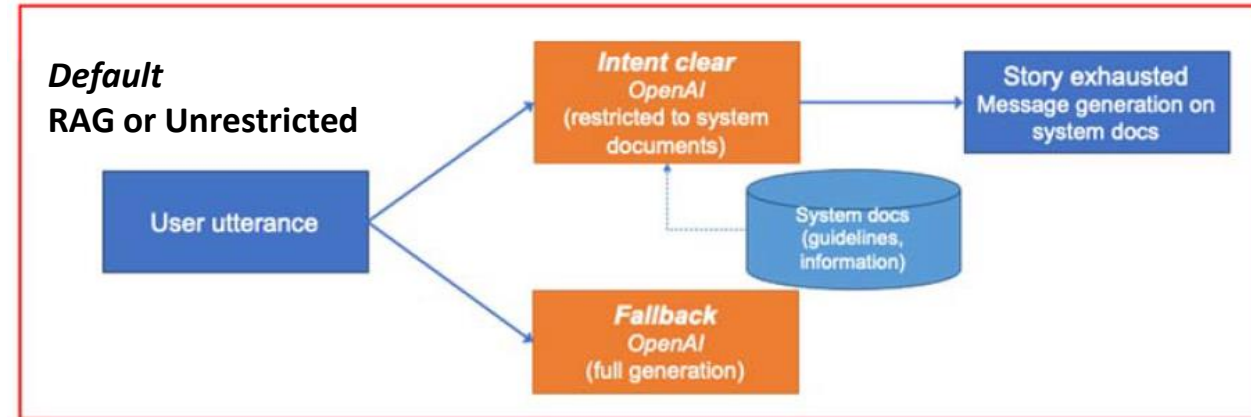
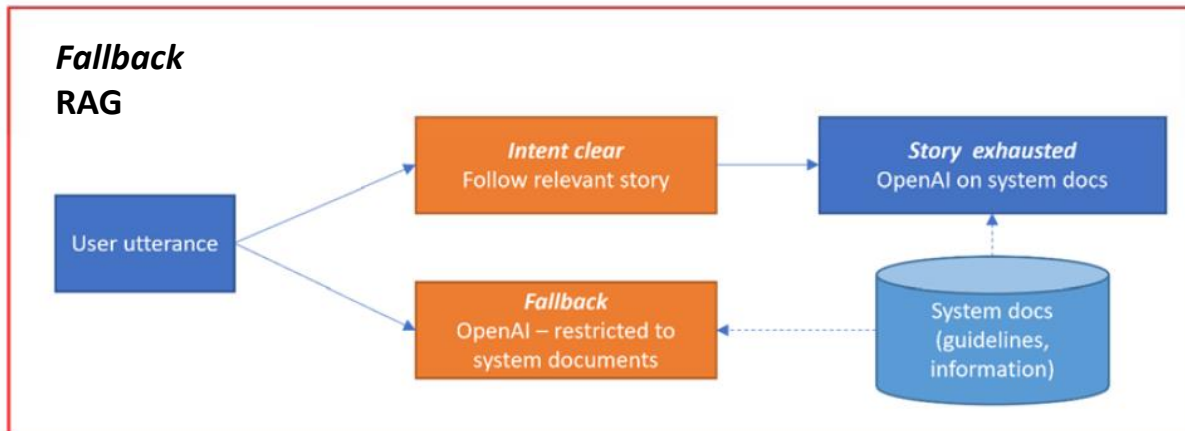
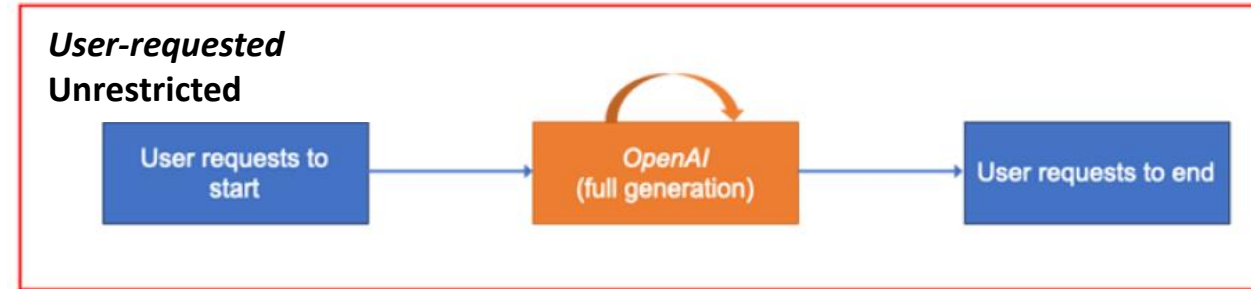
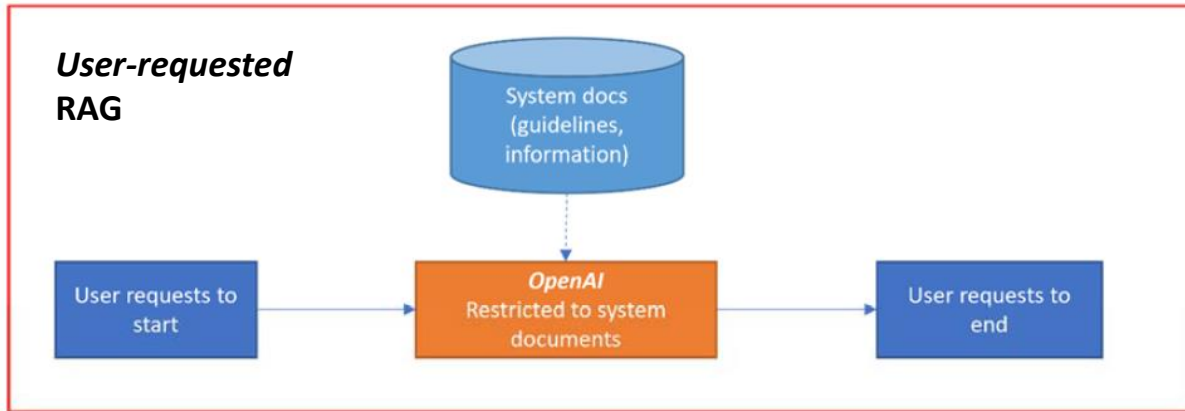




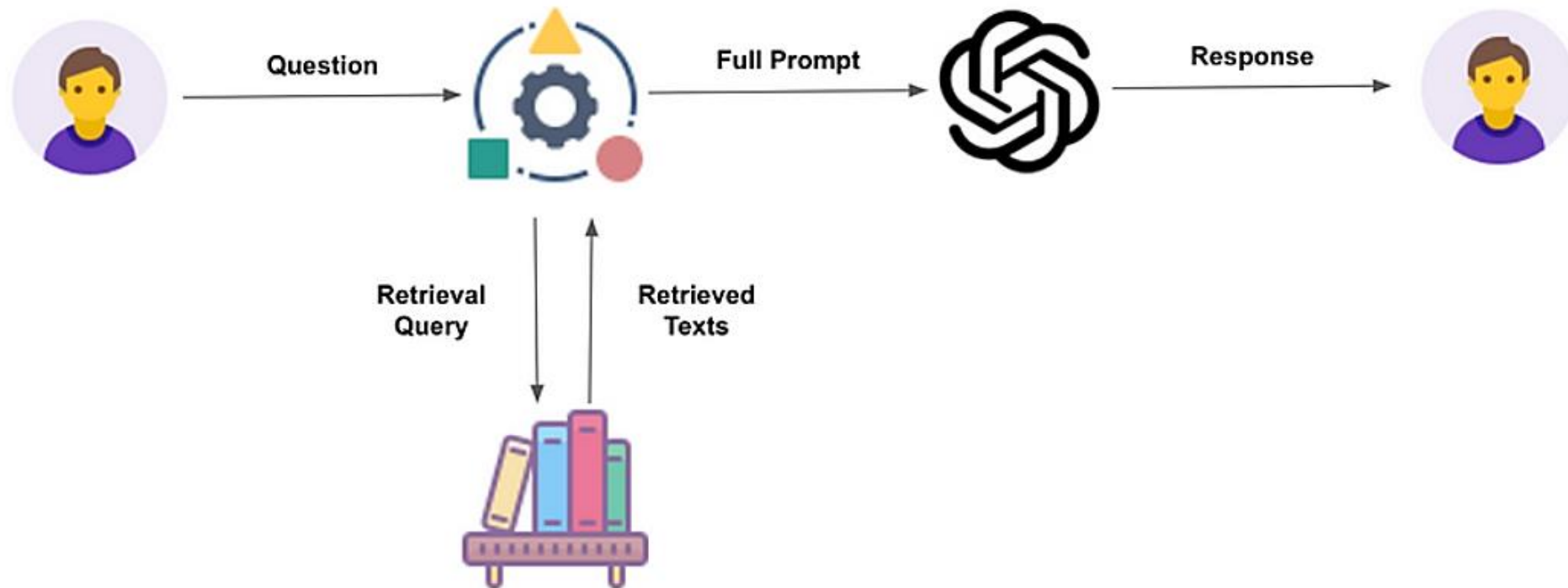
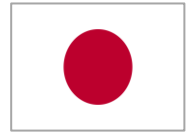
# OpenAI LLM use options



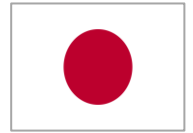
The call to OpenAI API may be initiated explicitly or implicitly



# RAG: Retrieval Augmented Generation



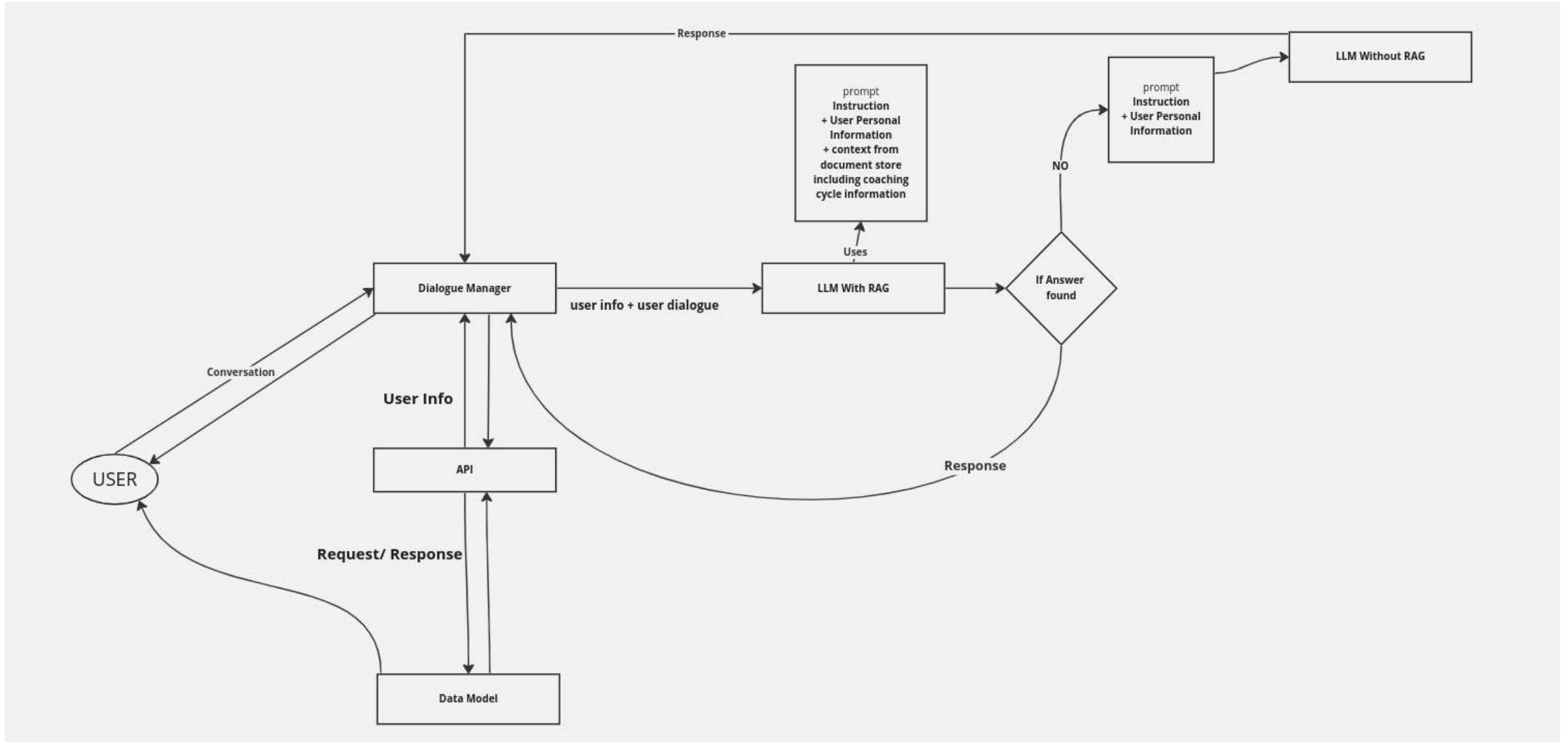
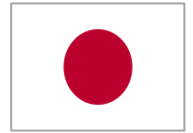
# Dialogue Manager



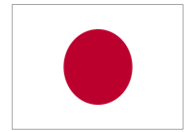
## Core Components

- Regular Dialogues: Typical Stories from RASA
- LLM Assisted Dialogues: Retrieval Augmented Generation , Coaching cycles
- Open end conversation : Use open internet

# Dialogue Manager



# Dialogue Coaching



## Coaching Cycle Concept: Use of RAG via OpenAI LLM, with importance on prompt engineering

- **For Not interested person:**

Mainly "**working on the idea**". The goal is to make them aware of the need for behavior change. Increase their knowledge of health behaviors and help them understand the benefits of behavior change and the risks of not doing so. Also, we ask users to express their feelings.

- **For Interested person:**

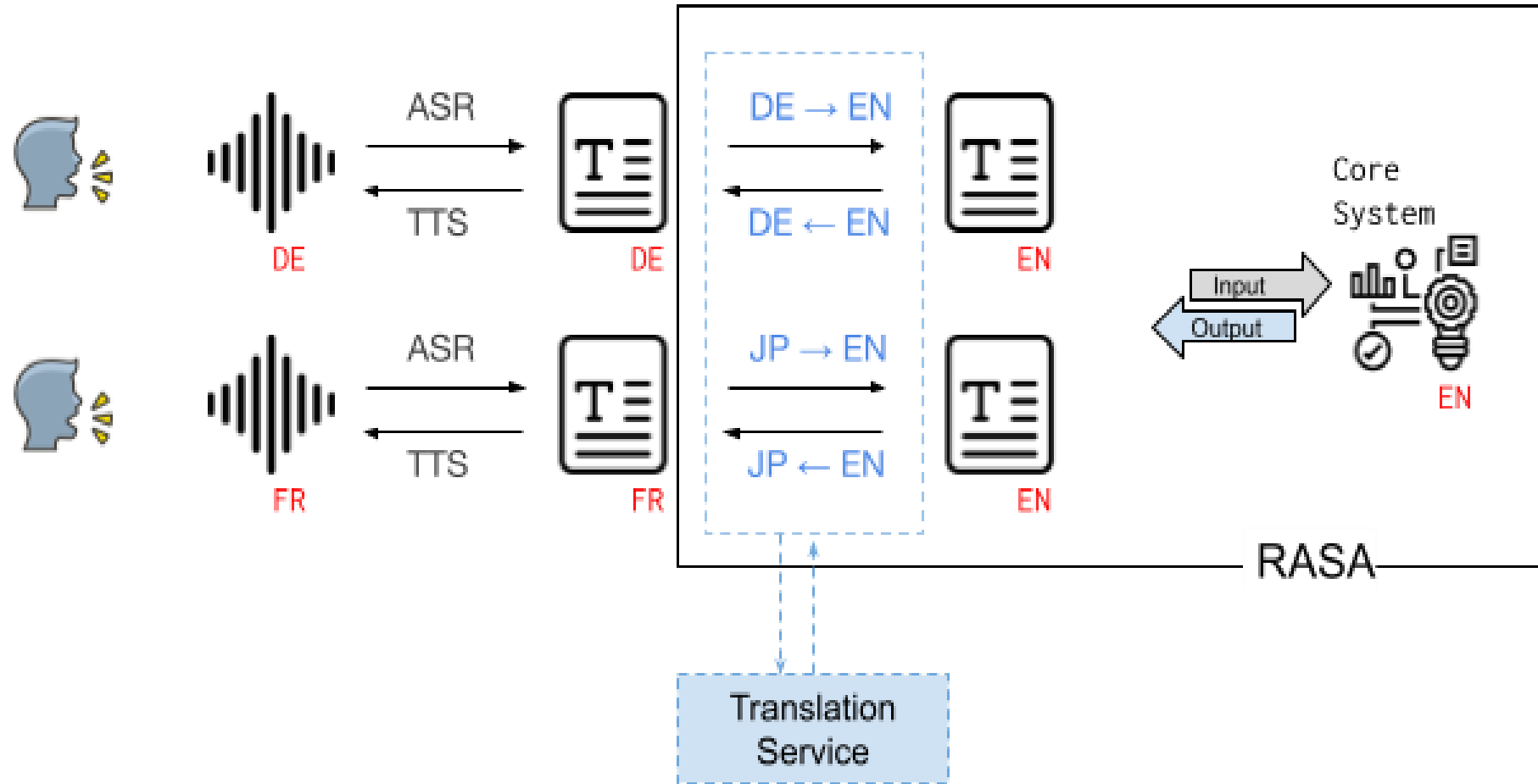
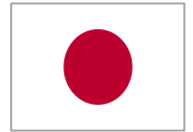
The main focus is on "**giving on the idea**". The goal is to motivate them and give them more confidence in their ability to change their behavior. Identify obstacles to behavior change. Continue to increase knowledge of health behaviors.

- **For Prepared person:**

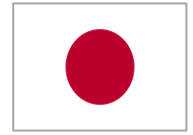
Main focus is on "**working on behavior**". Clarify the action plan. Have them make a concrete and achievable plan and be determined to implement the behavior. Once they have started even a little, follow up with them so that their determination does not waver. To encourage the use of self-monitoring, rewards such as points, and social support.



# Multilinguality



# Knowledge models



The e-Vita coach has various knowledge sources:

- Wikipedia
- Expert provided document library
- Sensor information (dynamic)
- User preferences, likings, coaching styles
- User utterances

Semantically-rich knowledge graphs for coaching

- Develop and employ
- Future comparison with text documents  
see the side workshop on LLMs and KGs afterward the main conference
- Exploring GPT-model with RAG for Trustworthy Interaction
- **distinguish** between interested and non-interested users
- provide training plans, but need to **check validity**
- Dialogue **continuation** needs to be secured

