Internet of Things for Ambient Assisted Living

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Introduction

Internet of Things

During the past decade, Internet of Things has been extensively applied to several sectors that range from industry to smart cities.

One of those is the healthcare sector, in which IoT not only enables new scenarios of healthcare delivery but it also changes how healthcare is practiced.

Some current services, and applications of healthcare IoT:
- Ambient Assisted Living
- Remote health monitoring
- Single/multiple health parameter/s monitoring: ECG monitoring, glucose level, blood pressure, body temperature, heart rate
- Clinical Decision Support System (CDSS): Automated prediction and diagnosis
- Community healthcare
- Medication management
- Real-time resource tracking
- Elderly care
- Physical activities: Rehabilitation, Fitness
- Stimulation of cognitive activities
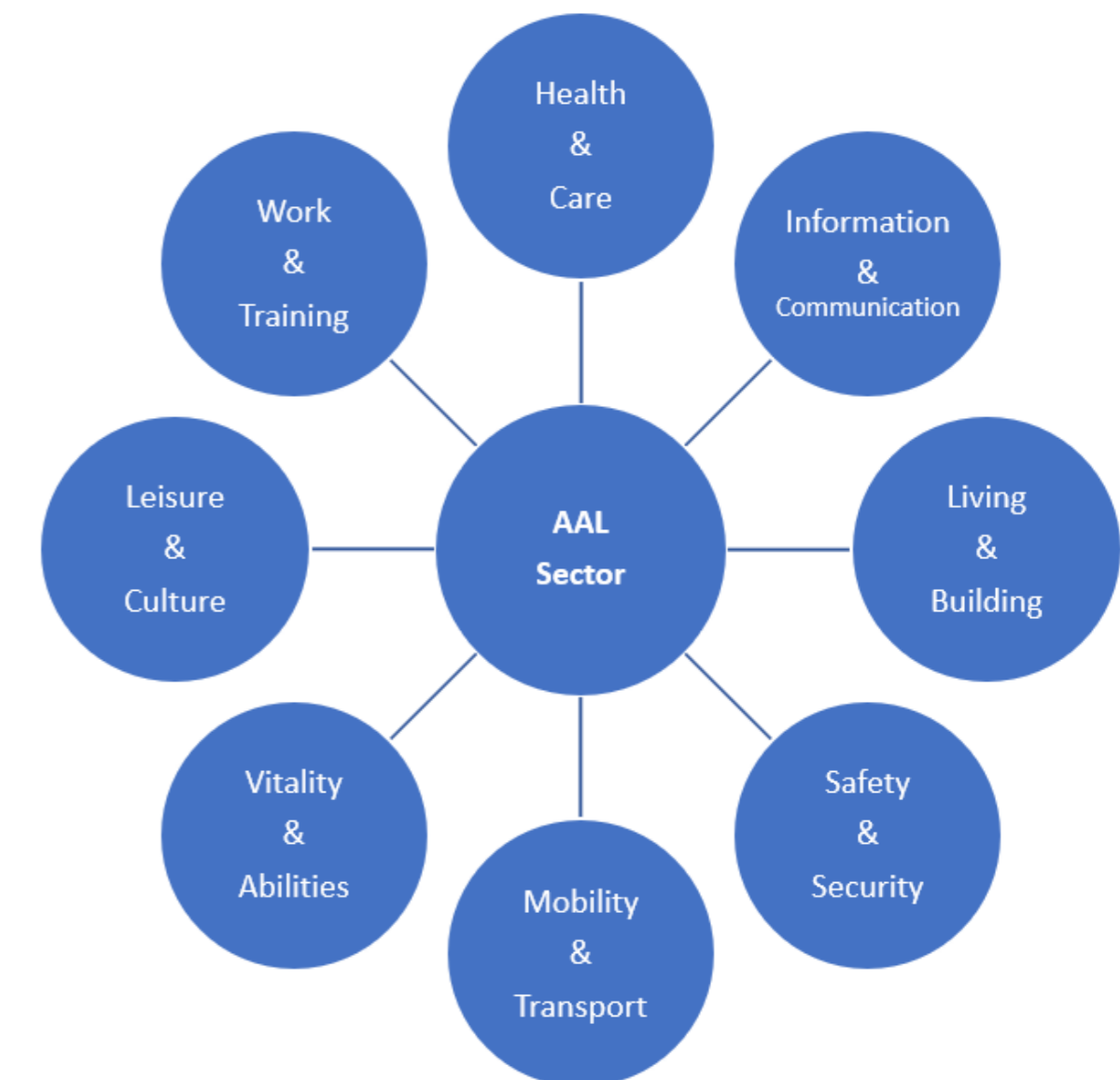
Introduction
Ambient Assisted Living

Ambient Assisted Living is a concept in which solutions that include one or more Information and Communication Technology components (including home automation systems) help elderly people (or people with special needs) to live with a degree of independence in their preferred environment for as long as possible.

Active and Assisted Living (AAL) is a European programme funding innovation that keeps people connected, healthy, active and happy into our old age.
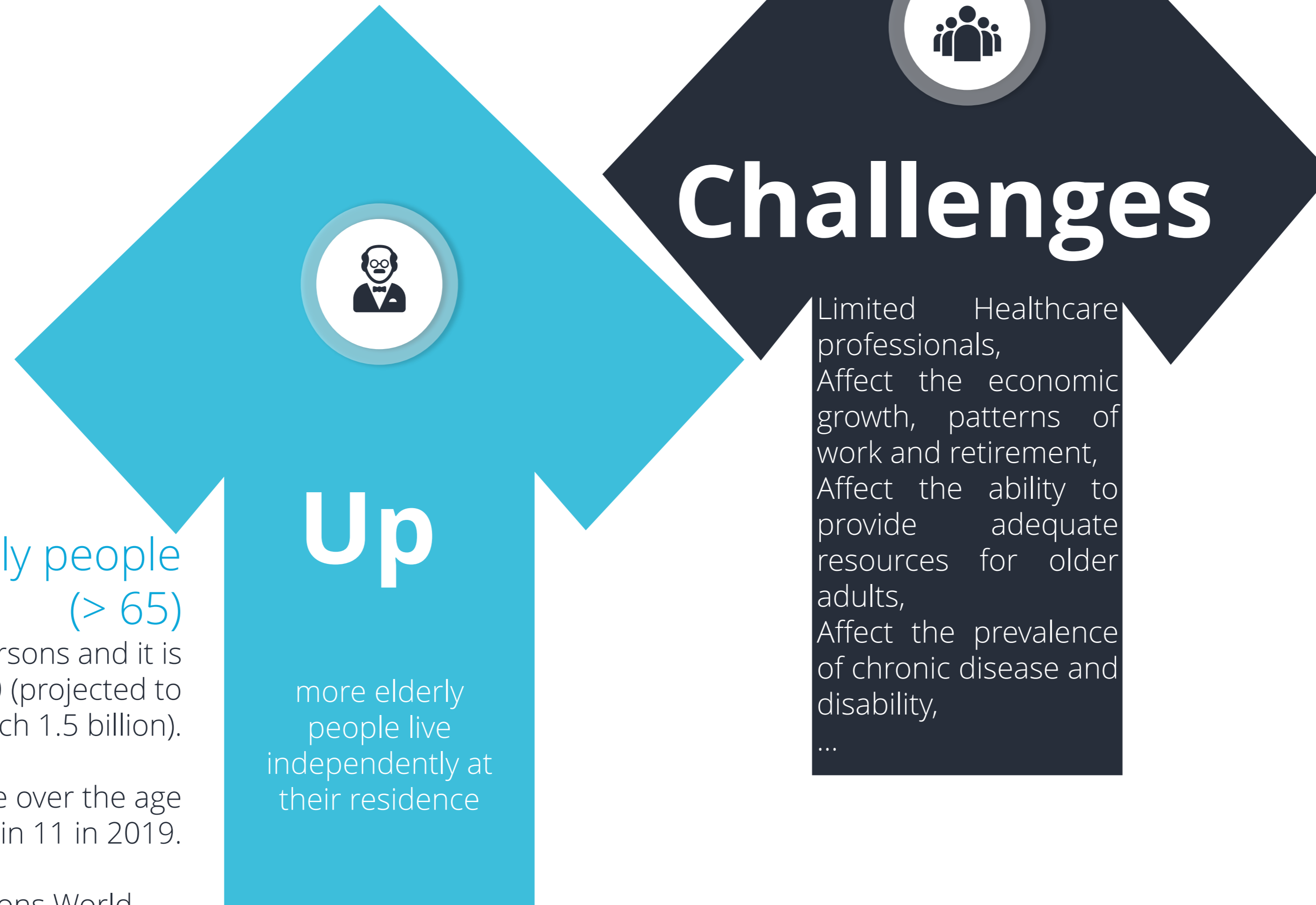
According to the AAL association, the AAL sector covers eight service areas:

Ambient Assisted Living
Motivation (1)

Our world is growing older!

"While the increased longevity and improved health at older ages seen in many parts of the world represent one of the crowning achievements of the 20th century, these trends also present significant challenges."

Up

more elderly people live independently at their residence

Challenges

Limited Healthcare professionals,
Affect the economic growth, patterns of work and retirement,
Affect the ability to provide adequate resources for older adults,
Affect the prevalence of chronic disease and disability,
...

The number of elderly people (> 65)

reached in 2019 703 million persons and it is expected to double by 2050 (projected to reach 1.5 billion).

in 6 people in the world will be over the age 65 by 2050, up from 1 in 11 in 2019.

"According to the United Nations World Population Ageing 2019 report "

Technology can play a main role to solve this issue.

Ambient Assisted Living

Motivation (2)

Our world is growing older!

"While the increased longevity and improved health at older ages seen in many parts of the world represent one of the crowning achievements of the 20th century, these trends also present significant challenges."

Technology can play a main role to solve this issue.

Video source: Ageing Well in a digital world, AAL website - www.aal-europe.eu

AAL PROGRAMME

Ambient Assisted Living
Challenges

Different challenges should be taken into consideration during the design and development processes of any Ambient Assisted Living system such as:

Accessibility
the system should be accessible to its different users (main end users, health professionals, family members).

Security
the system should not be accessed by unauthorized parties neither the data.

Data Communication with health professionals
communication of the necessary data in a secured and structured manner. Follow the Health Level Seven (HL7) standards.

Privacy
user should know what data is shared the user should be have control over it only necessary data should be shared with specific parties.

Additional Challenges
Compatibility of devices, Maintenance and management, Connectivity and bandwidth, Adaptation and personalization, Acceptance of the system.

Data Validation & Fusion
the system should validate the received data, the system should be able to integrates in real, time the data obtained from multiple sources.

Ambient Assisted Living

Challenges / Accessibility

Each Ambient Assisted Living system should integrates a multimodal interface that support easy and natural interactions between the user and the system.

The challenges related to interaction between the user and the system can be divided into two main groups:

- challenges related to human factors,
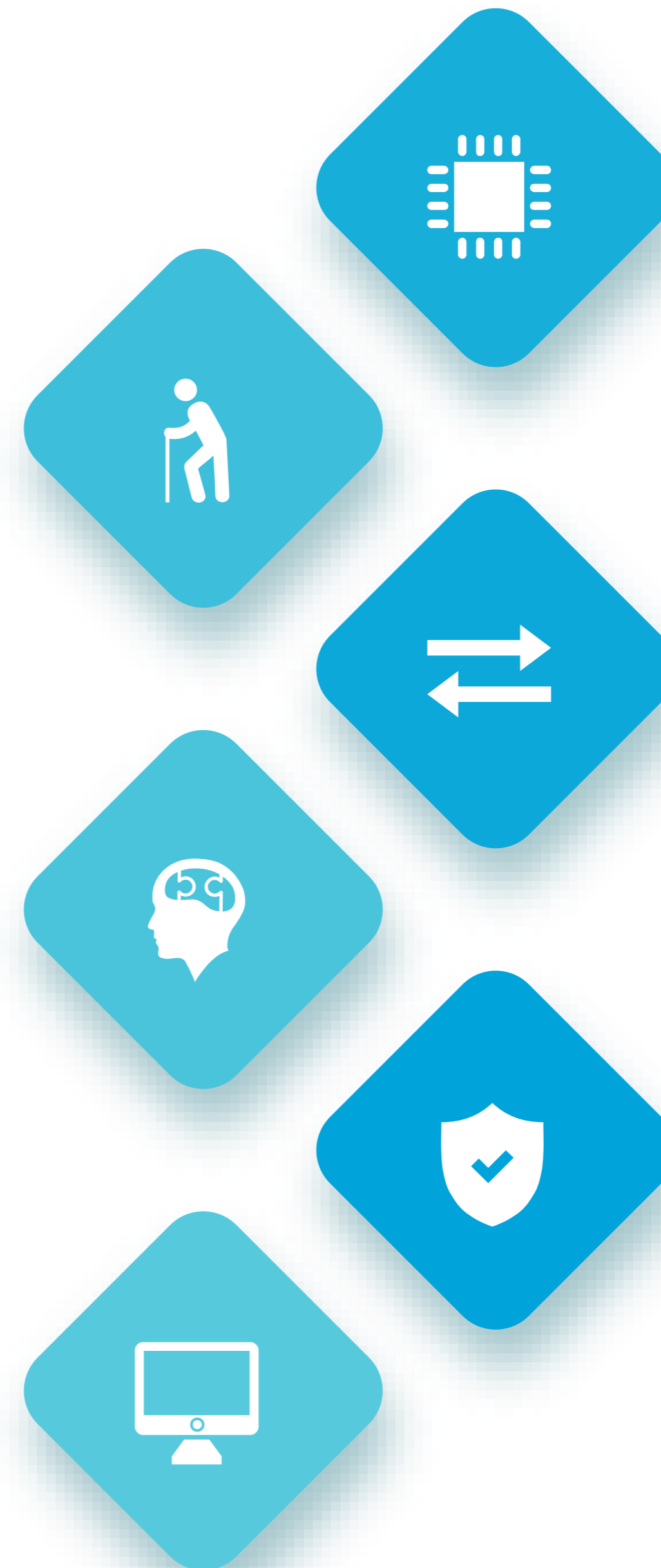- challenges related to technical factors.

Traditional Interfaces always represented a barrier between elderly people and technology.

Fusion of Data
input data that come from the different input channels

Physical issues
caused by the physical condition of the elderly
the most apparent issues

Contradictory Commands
received at the same time

Cognitive issues
that result from ageing

Security and Privacy
sensitive data
data collection & processing

Computer Experience & Cultural Background
affects how users interact with the systems

Ambient Assisted Living

Challenges / Accessibility - A Model for Multimodal Human-Machine Interaction

Any interaction between a user and a machine can be divided in eight states.
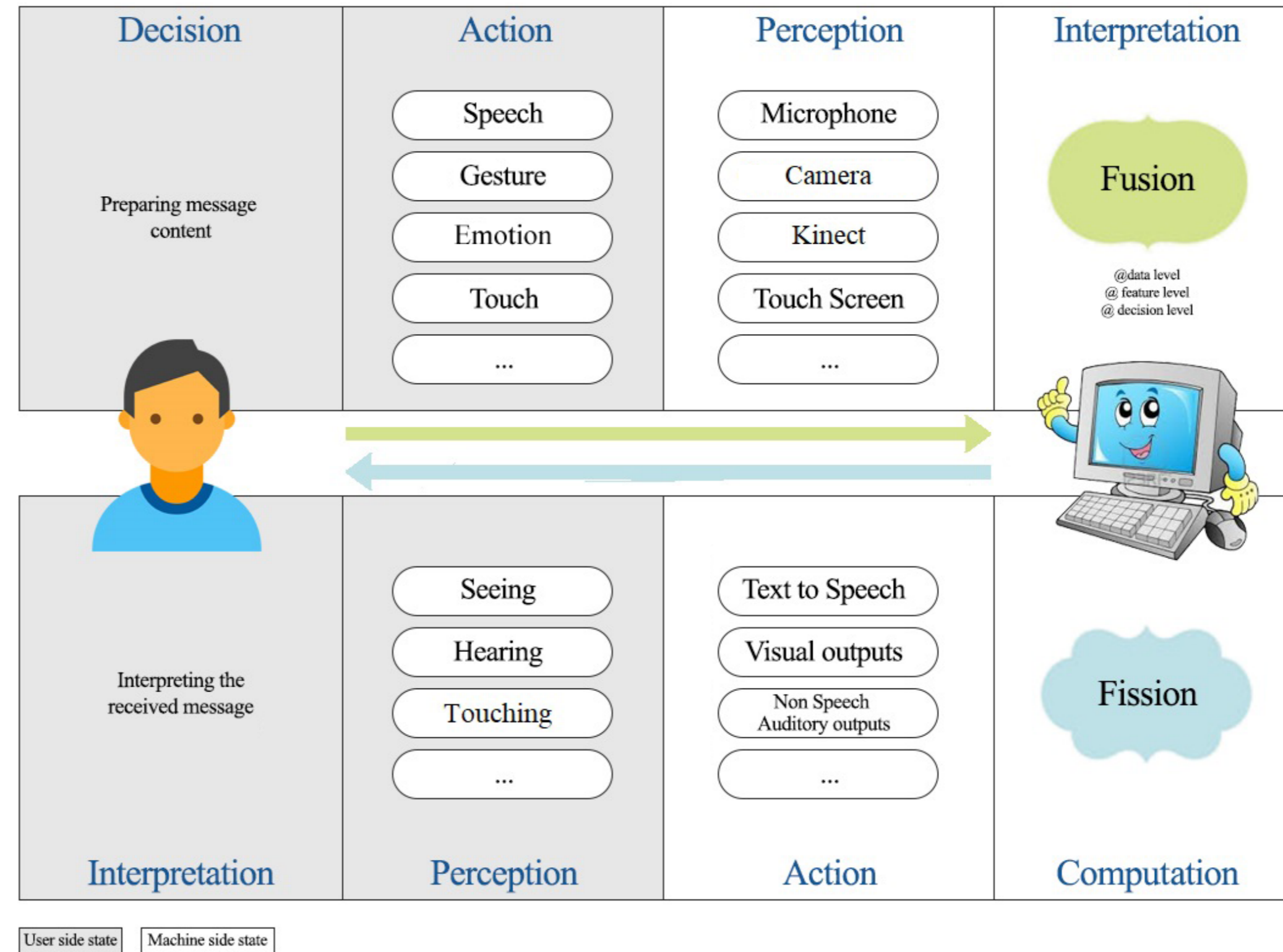
Ambient Assisted Living Systems

CAMI - Artificial intelligent ecosystem for self-management and sustainable quality of life in AAL / The Concept

CAMI offers a Core System Component that provide different services to the user:

- the capability of health, home and environment monitoring and management,
- an intelligent, informed, friendly collaborator, taking orders, giving advice or reminders and ready to help, and get help, when needed,
- a platform that offers a personalized, intelligent and dynamic program management also reporting and communication to health professionals,
- telepresence for communication (video, voice) with caregivers, family, friends through multi-modal interfaces.

CAMI Consortium: 8 partners from 5 countries (Romania, Denmark, Poland, Sweden and Switzerland).
The CAMI project was founded by the European Union through the "Ambient Assisted Living" Programme.
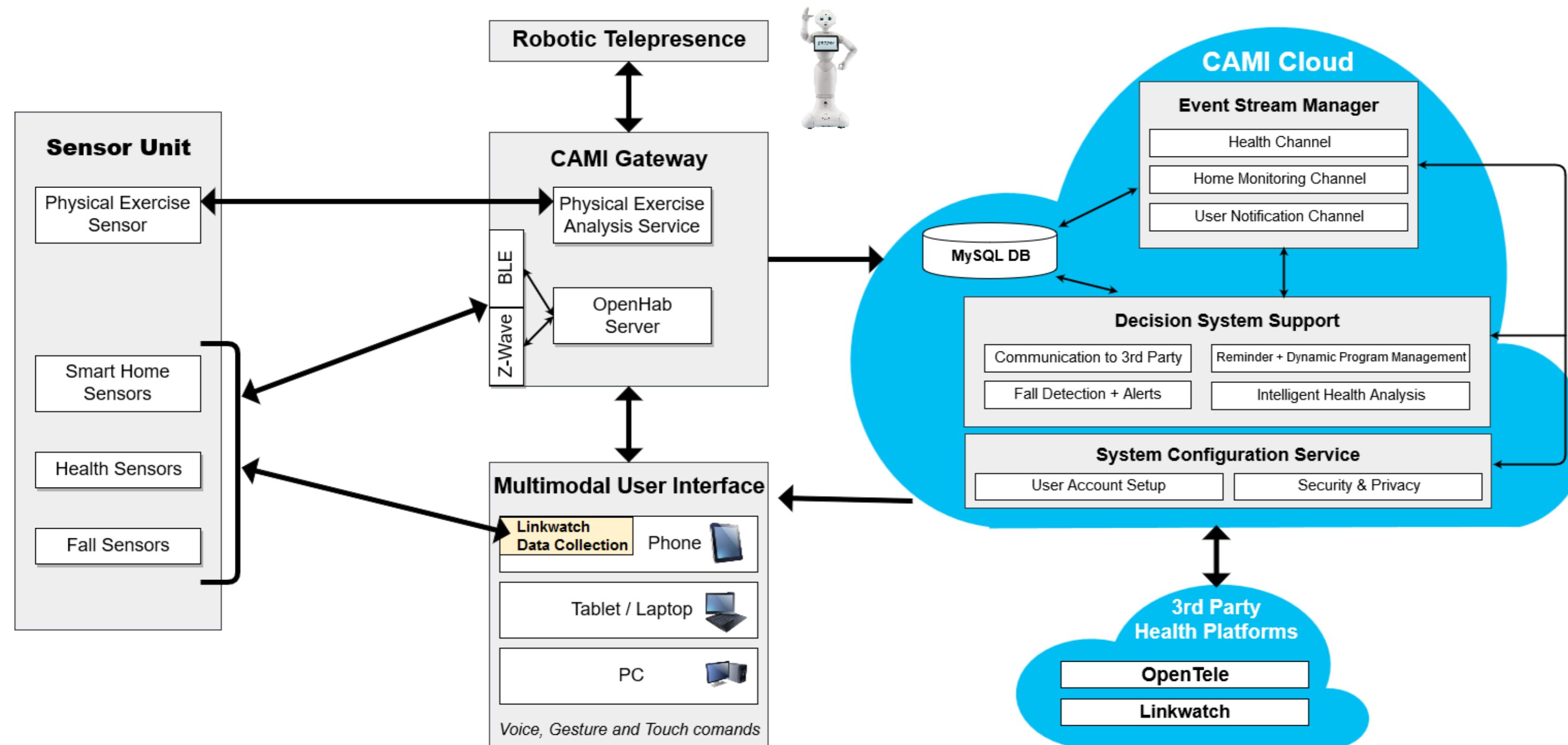Project ID: AAL-2014-1-087.
Project Website: www.camiproject.eu
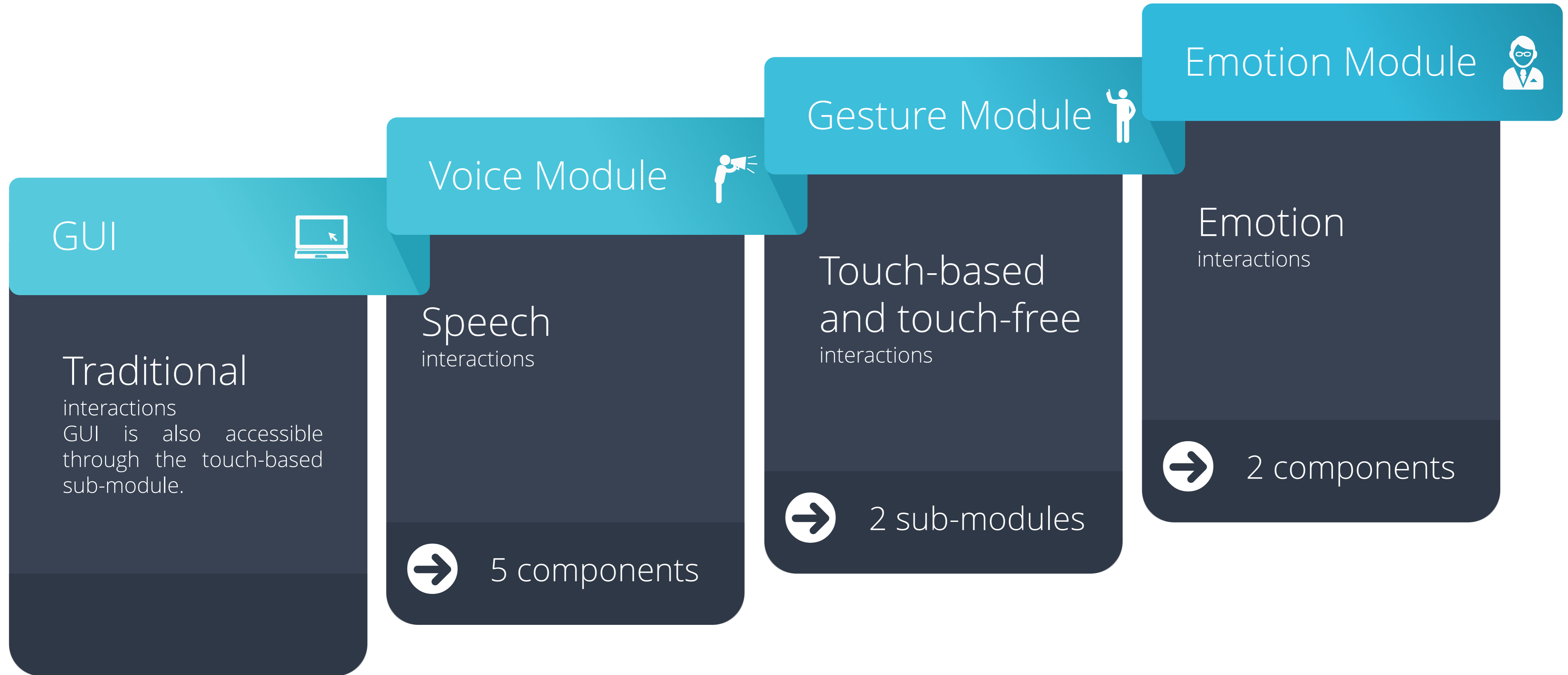
Ambient Assisted Living Systems
CAMI / A Modular Architecture

CAMI was developed based on different technologies of the partners, included a configurable architecture and different processing modules, as well as different computing devices to access these modules.
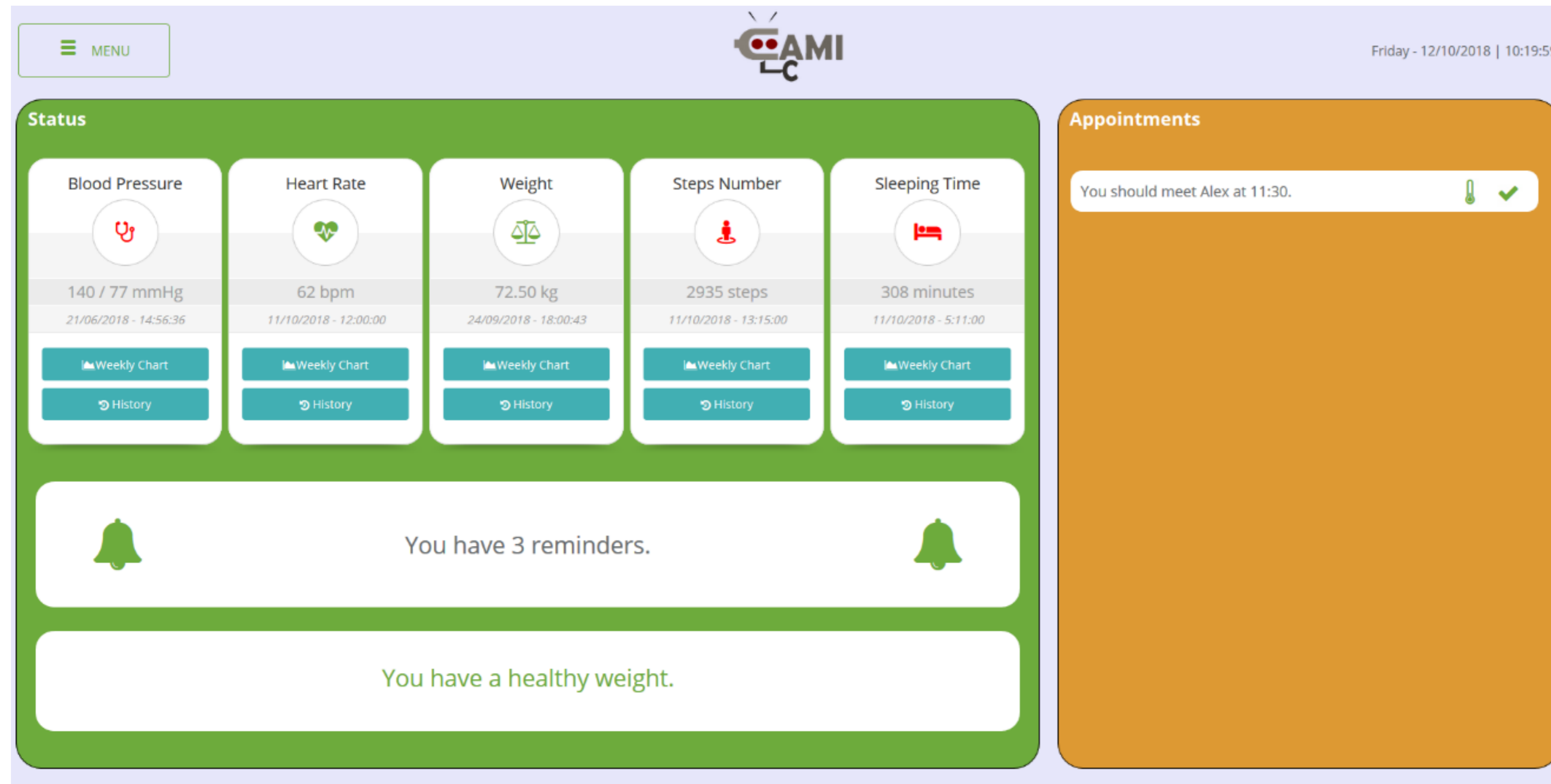
Ambient Assisted Living Systems

CAMI / An Adaptive Multimodal Interface for CAMI

Emotion Module

Gesture Module

Voice Module

GUI

Emotion
interactions

Touch-based and touch-free interactions

Speech interactions

Traditional
interactions
GUI is also accessible through the touch-based sub-module.

→ 2 components

→ 2 sub-modules

→ 5 components

Ambient Assisted Living Systems

CAMI / An Adaptive Multimodal Interface for CAMI - GUI (1)

- Ergonomics:
  - simple design,
  - easy navigation,
  - respected the requirements of elderly people,
  - behave on a consistent way through the different pages and on different devices,
  - easily interpretable visual clues and default colors,
  - information categorized by category...

- Cross Platform
  - designed to work on any device or any operating system,
  - the user can interact smoothly with the system through any device(s) that the user already has or prefers to use *(one or more)*.

Ambient Assisted Living Systems

CAMI / An Adaptive Multimodal Interface for CAMI - GUI (2)

Heart Rate Weekly Chart
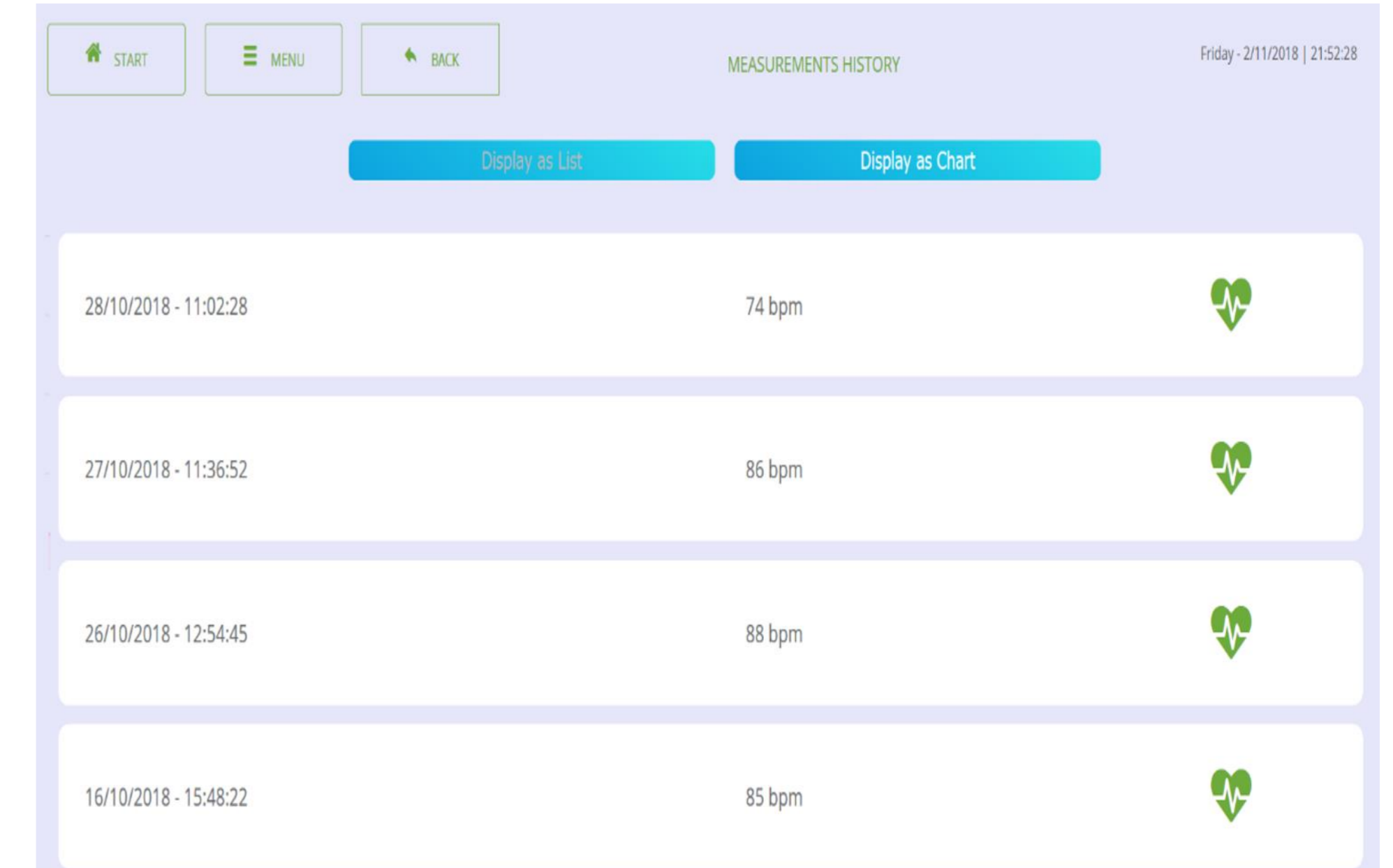
Heart Rate Measurements History – List View

Different reports can be generated and multiple views are available

Ambient Assisted Living Systems

CAMI / Personalization

Some Personalization features:

User:
- Choose which modules to display on the home page and in what order,
- Customize colors of the different elements of the interface,
- Choose colors of the messages *(danger status, normal status and attention needed status, etc.)*,
- Order of the buttons in the menu,
- The form of the system's feedback,
- Preferred time frame for exercising,
- Adjust the feedback preferences,
- Activating or disactivating the automatic adaptation features,
- Activating or disactivating a specific input modality,
- Activating or disactivating the multi-touch gestures...

Caregiver:
- Medication plan for the user,
- Health profile of the user *(including the accepted rate of values for each health measurement)*,
- Exercises the user should practice,
- Alerts...

Ambient Assisted Living Systems

CAMI / Automatic Adaptation

Some Automatic Adaptation features:

Based on the user's activity:
- the system monitors the activity of the user and adapts the interface according to the needs of this activity.

Based on the user's status:
- the system monitors the emotional status of the user and adapts the interface to the user's emotional status, it can also send notifications in case of bad emotions,
- the system regenerates the interface to suit best the health conditions of the user.

Based on the user's environment:
- the system monitors the environment of the user and adapts the interface to best suit the conditions of the environment.

Based on the system configuration:
- the interface regenerates itself to suit best the configuration of the system.

Ambient Assisted Living Systems

IONIS - Indoor and outdoor NITICSplus solution for dementia challenges

IONIS

IONIS ease the life of informal caregivers of people with mild dementia.

It allows informal caregivers to know that the caretaker is safe and they have to be ready for personal support when it is needed.

IONIS enables real-time remote tracking of the status and health of the user. It integrates technologies and services that address dementia specific challenges and offer support to both caretakers and caregivers alike.

Main IONIS functions:

• Detailed health monitoring.
• Fall detection and alert.
• Sleep monitoring.
• Memory and cognitive support (object localization, smart mobility tracking, wandering detection).
• Indoor and Outdoor localization, geofencing.

IONIS Consortium: 10 partners from 5 countries (Switzerland, Poland, Romania, Hungary and Slovenia).
The IONIS project was founded by the European Union through the "Active and Assisted Living" Programme.
Project ID: AAL2017-AAL-2016-074-IONIS-2
Project Website: https://ionis.eclexys.com

AAL
PROGRAMME

Ambient Assisted Living Systems

INCARE - Integrated Solution for Innovative Elderly Care

INCARE is a software platform compatible with:
- health devices,
- home automation sensors,
- robots.

INCARE is dedicated to the elderly living independently or in elderly care facilities.

INCARE platform aims to help them live longer, more connected and more independent.

INCARE turn national and European funded projects into viable products by building on two successful solutions developed within previous AAL and European projects: NITICS and RAPP.

INCARE Consortium: 8 partners from 4 countries (Romania, Switzerland, Poland and Hungary).
The INCARE project was founded by the European Union through the "Active and Assisted Living" Programme.
Project Website: www.aal-incare.eu
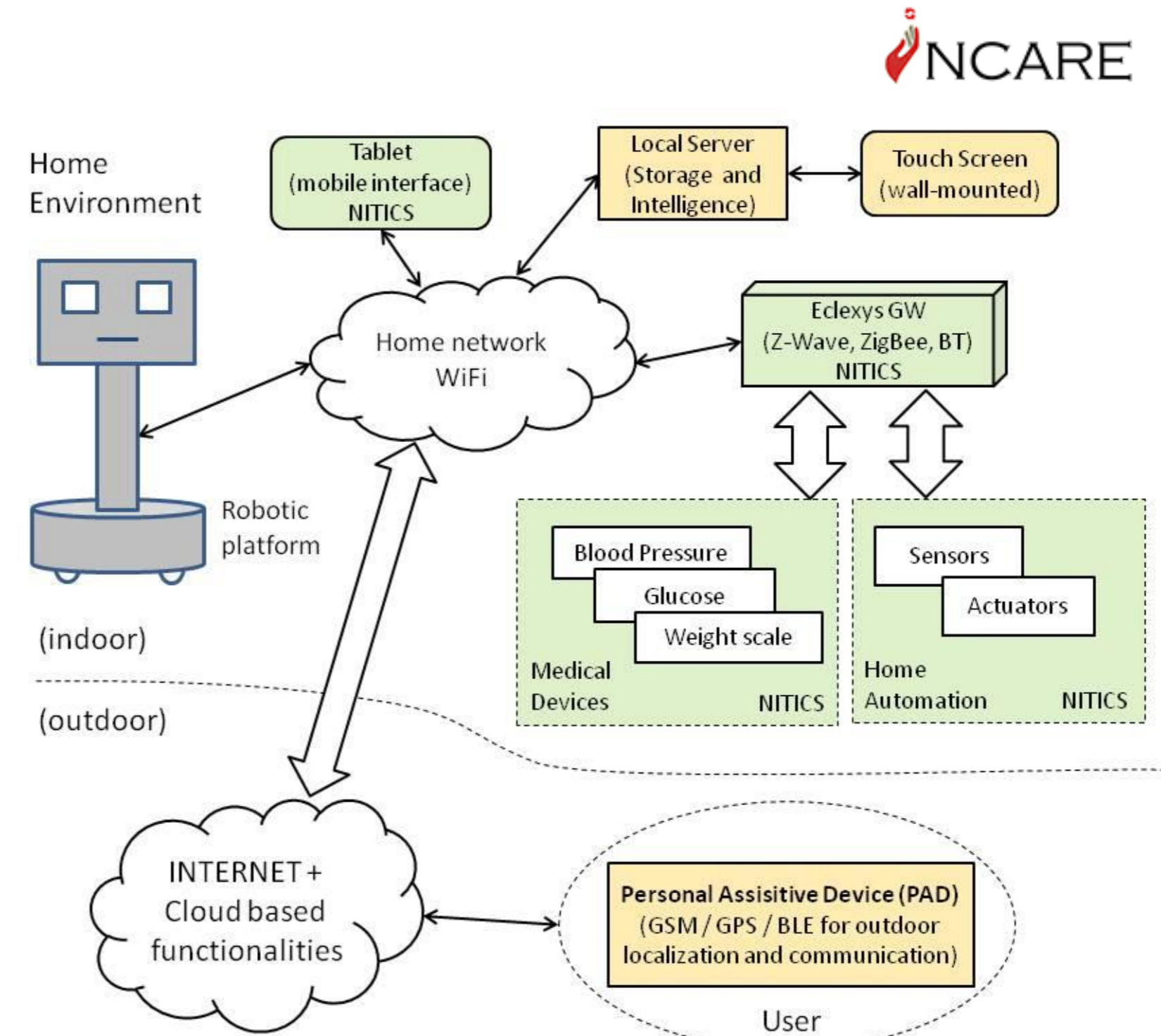
Ambient Assisted Living Systems
Demo

Ambient Assisted Living Systems

Feedback (1)

X 50

- The users apreciated much:
  - Adjusting:
    - the language of the interface,
    - the mode of working for the voice module (online/offline),
    - the colors of the alerts, icons and texts,
    - the different units of measurement and the date/time format.

  - Activating and Disactivating:
    - automating adaptation,
    - multi-touch gestures,
    - each module of the interface and of the system (having control about what data is shared).

  - Adaptation:
    - according to the user profile.

Ambient Assisted Living Systems

Feedback (2)

X 50

- The users apreciated:
  - Adaptation according to the environment conditions,
  - Adjusting the form of the system's feedback and the font-size.

- The users apreciated less:
  - Adaptation according to the user activity,
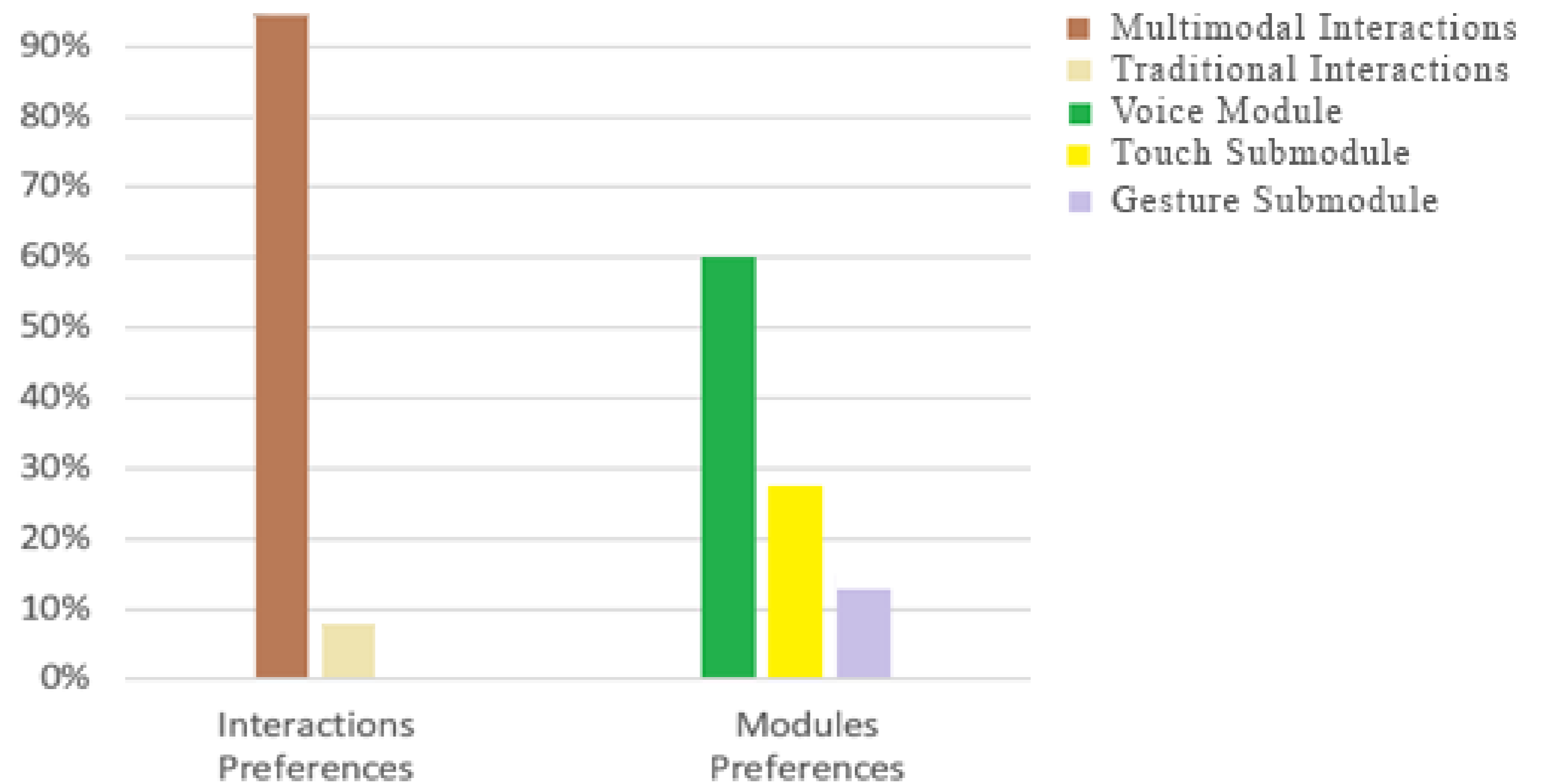 - Adjusting the colors of the buttons and background.

- The users found useless:
  - Adaptation according to the user emotional status,
  - Adjusting the order of buttons and input modalities preference order,
  - Adjusting the order of modules.

The acceptance of the presence of a robotic platform (Pepper or TIAGo) in the different systems that have been evaluated has clearly varied depending on the country from which the users' comes from.

Ambient Assisted Living Systems
Ways of Interaction Feedback

X 50

Thank You | Any Questions?