1

Background (SUITCEYES)

Progress so far:

- Perception of the environment
- communication and exchange of semantic content
- Joyful learning and life experiences

2

Project details

2018 - 2020

€ 2 359 962

EU Horizon 2020

Score: 14.5

Smart, User-friendly, Interactive, Tactual, Cognition-Enhancer, that Yields Extended Sensosphere

Appropriating sensor technologies, machine learning, gamification and smart haptic interfaces

SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

3

Partners

- University of Borås (HB)
- Centre for Research & Technology Hellas
- University of Offenburg (HSO)
- University of Leeds (UNIVLEEDS)
- Eindhoven University of Technology (TU/e)
- Les Doigts Qui Rêvent (LDQR)
- Harpo Sp. z o.o. (HARPO)

HÖGSKOLAN I BORÅS
CERTH CENTRE FOR RESEARCH & TECHNOLOGY HELLAS
Hochschule Offenburg offenburg.university
UNIVERSITY OF LEEDS
TU/e Technische Universiteit Eindhoven University of Technology
HARPO

4

deafblindness

Image is used with permission by Mo Gård

Nordic Definition of Deafblindness

Nordens välfärdscenter

Deafblindness is a combined vision and hearing impairment of such severity that it is **hard for the impaired senses to compensate for each other**. Thus, deafblindness is a distinct disability.

SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

5

Actual

NUMBERS

very difficult to come by

6

State	Population	Expected population of deafblind people
Austria	8,219,743	43,367
Bulgaria	7,037,935	37,132
Catalonia	7,565,603	38,010
Croatia	4,494,749	22,582
Czech Republic	10,512,419	48,462
Denmark	5,534,738	26,213
Estonia	1,274,709	6,611
Finland	5,262,930	27,388
France	66,000,000	326,832
Germany	80,523,700	459,629
Greece	9,903,268	53,676
Hungary	9,981,334	47,272
Ireland	4,209,000	17,206
Italy	60,626,442	342,782
Lithuania	3,525,761	17,523
Malta	416,055	1,858
Netherlands	16,357,992	74,527
Poland	38,536,869	169,331
Portugal	10,781,459	54,942
Romania	21,848,504	101,901
Scotland	5,295,400	26,032
Slovakia	5,439,448	22,628
Slovenia	2,010,347	9,702
Spain	39,493,930	200,959
Switzerland	8,036,917	40,667
Turkey	75,627,384	237,016
United Kingdom	57,053,047	280,473
Total	565,569,683	2,734,721

There are approximately over 390,000 people in the UK with deafblindness.

Forecasted to increase to over 600,000 by 2035.

SENSE

http://siketvak.hu/wp-content/uploads/2014/07/Final-Report-Deafblind-Indicators.pdf

7

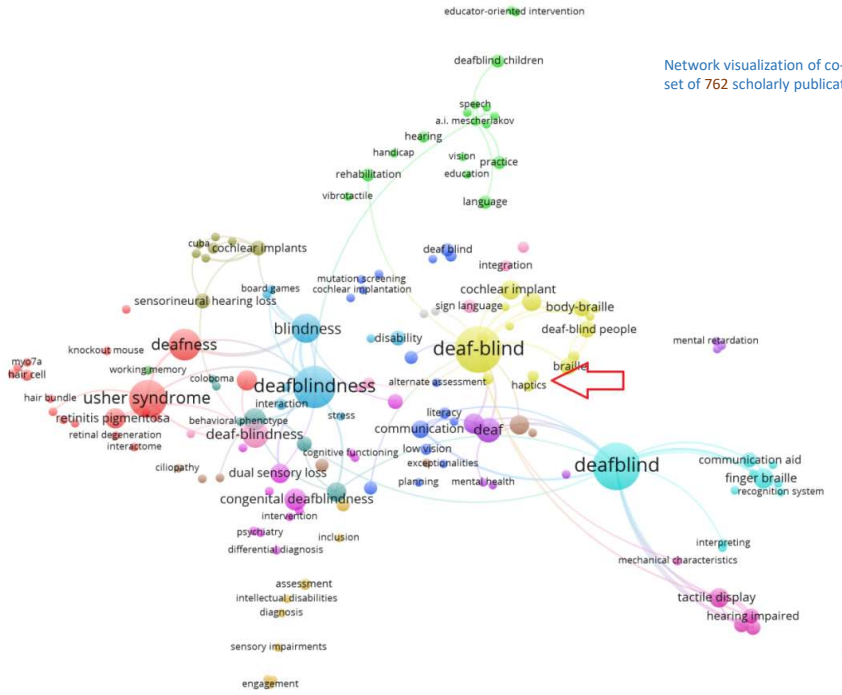
- Persons with deafblindness represent between **0.2%** and **2%** of the global population
- Deafblindness is often underestimated

http://www.internationaldisabilityalliance.org/sites/default/files/wfdb_complete_initial_global_report_september_2018.pdf

At risk of exclusion from CRPD and SDGs implementation:
Inequality and Persons with Deafblindness

8

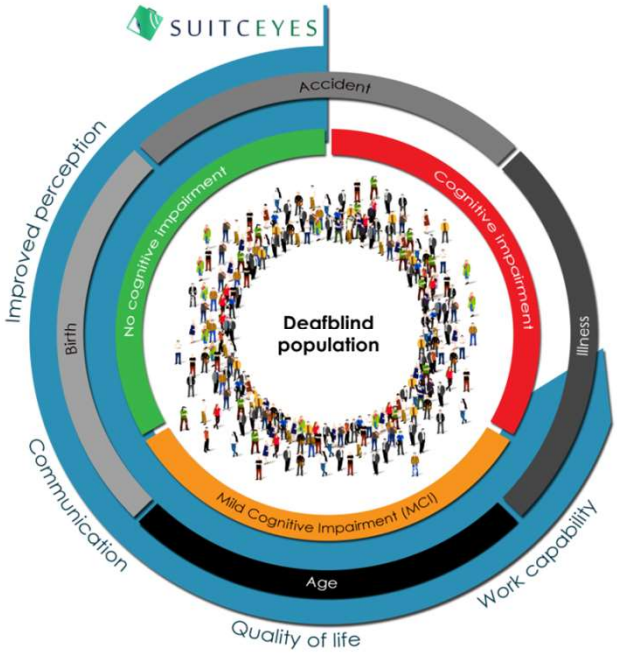
Related research



Network visualization of co-occurrence of author keywords based on a set of 762 scholarly publications (c.f. over 400,000 items on blindness)

SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

9



the idea

The overall objective of SUITCEYES is to improve the level of independence and participation of persons with deafblindness and to enhance their communication, perception of the environment, knowledge acquisition, and conduct of daily routines.

SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

10

Different views on disability

SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

11

the social model

- Disability is caused by the way society is organised rather than by a person's impairments or differences.
- Looks at ways of removing barriers that restrict life choices.
- If barriers are removed one can be independent and equal in society, with choice and control over one's own life.

SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

12

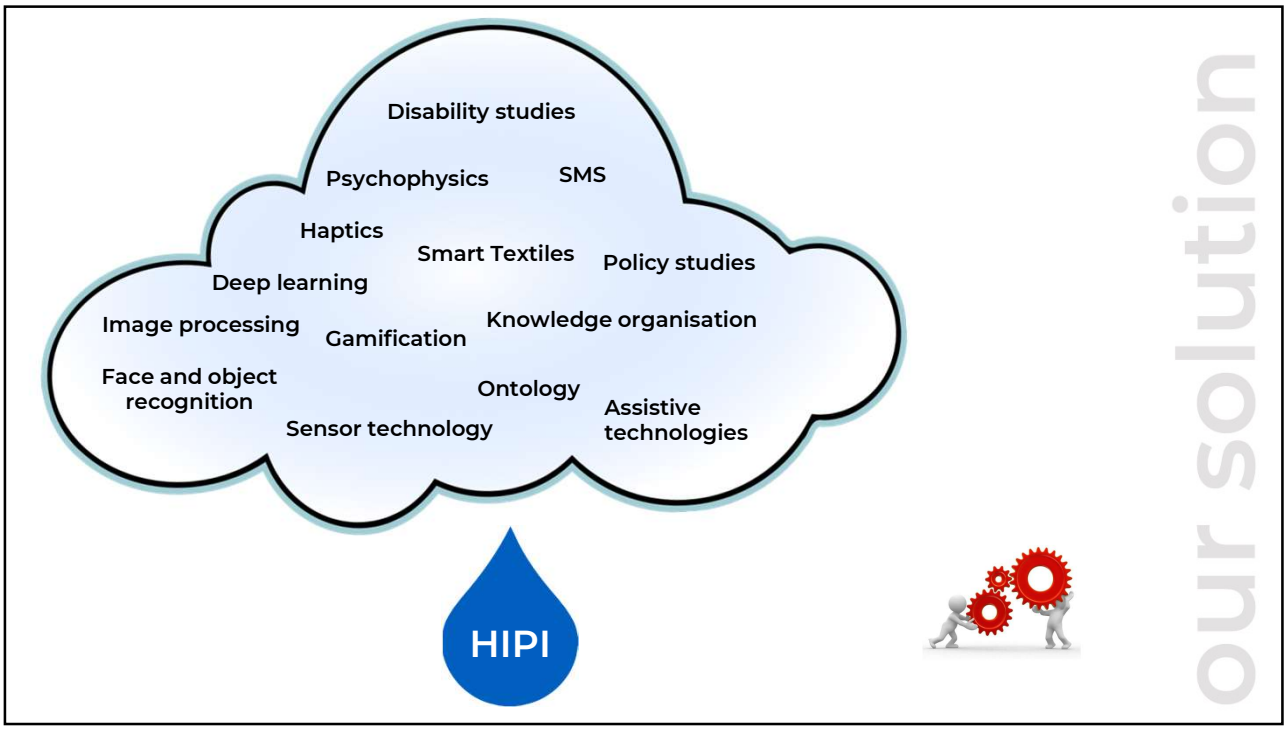
the social model

- In the philosophy and practice of **Independent Living**, the term 'independence' is redefined not to mean self-sufficiency, but rather **self-determination**.

SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

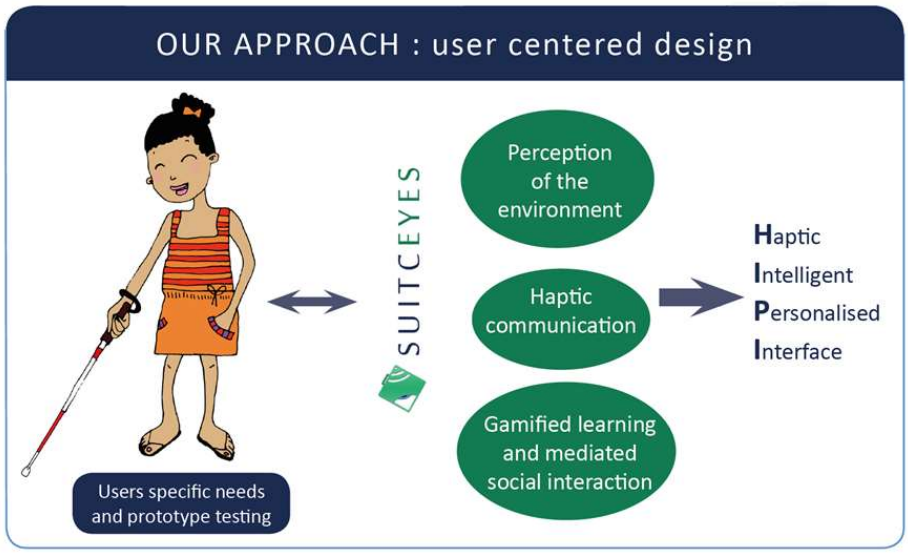
13

14



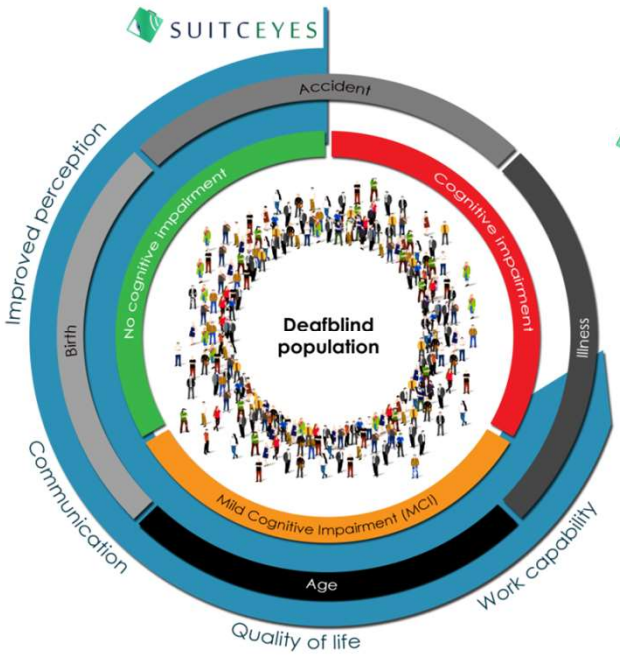
15

the HIPI



SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

16



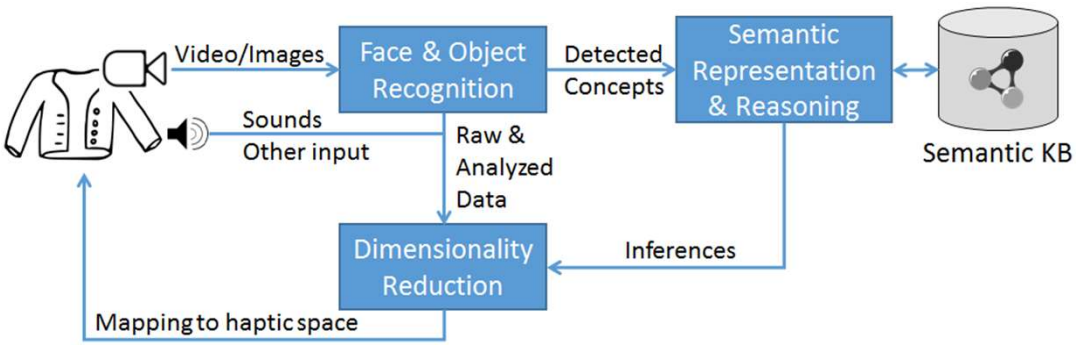
SUITCEYES will address 3 challenges:

- perception of the environment
- communication and exchange of semantic content
- Joyful learning and life experiences

SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

17

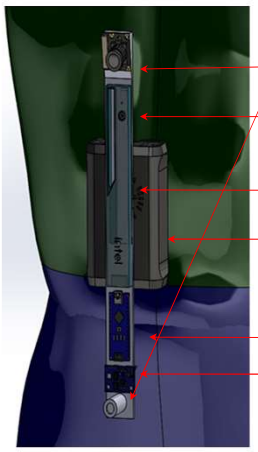
Data Capture, Recognition, Translation and Semantic Representation of Environmental Clues



SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

18

Capturing environmental cues



Sensor system

Line laser scanner

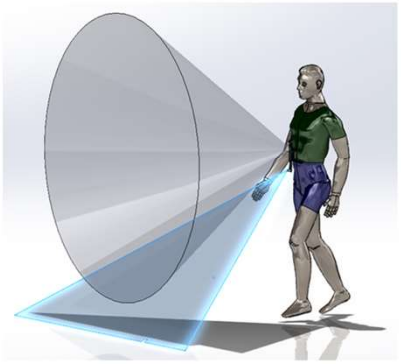
RGB-D camera-Realsense R200
(for T4.2)

Bluetooth

Raspberry Pi and UP Board controllers
(using ROS – Robot Operating System)

Arduino controller

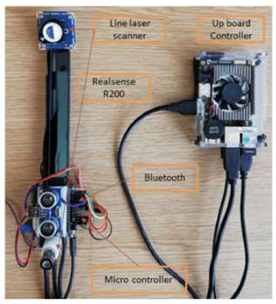
Inertial measurement unit(IMU)



SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

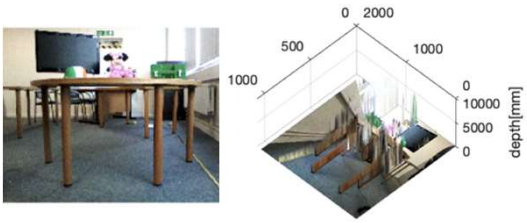
19

Initial Sensor System

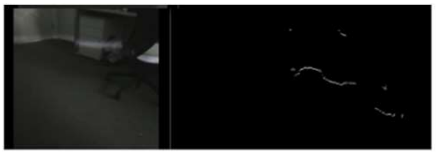


5 Kinds of Sensor Considered

- ✔Depth Camera
- ✔Ultrasonic sensor
- ✔Inertial measurement unit
- ✔Bluetooth Low Energy Beacons
- ✔Line Laser Scanner



Example of a depth image registered to an RGB image from Realsense R200

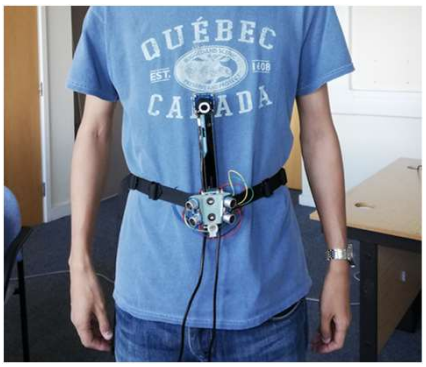


Example of point cloud returned by planar laser scanner

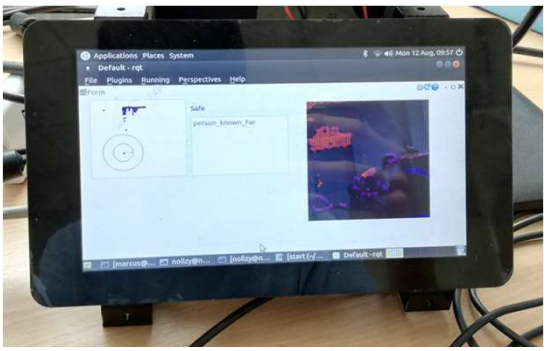
SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

20

System integration and verification



prototype a housing to mount the sensor array, processor and haptic actuators on the body



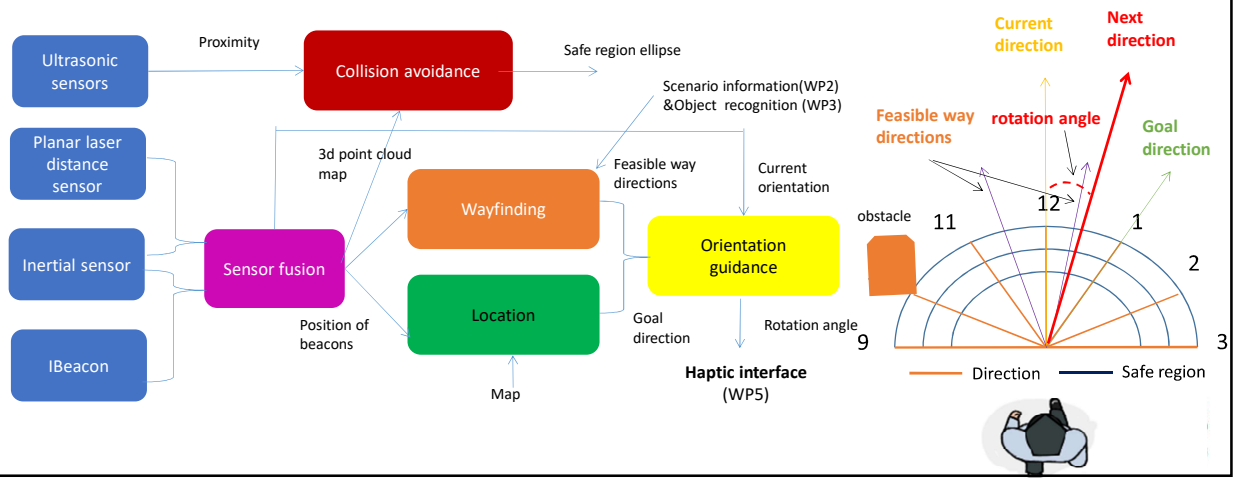
Data visualization for real time testing

SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

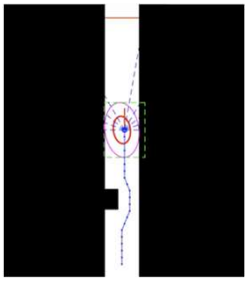
High level controller design

Implement algorithms to interpret the spatial information from the array of distance sensors in real-time

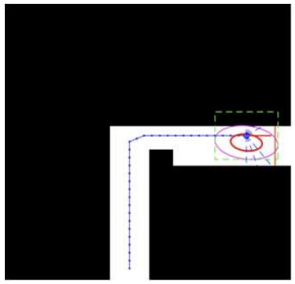
Proposed a new control strategy to interpret complex environment into haptic interface by using wayfinding, collision avoidance and orientation guidance algorithms



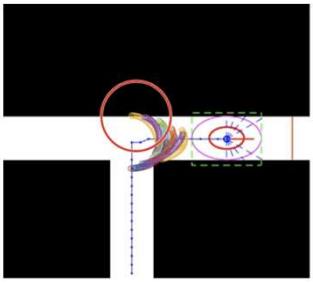
Verify safe ellipse using simulation



Collision avoidance



Turning

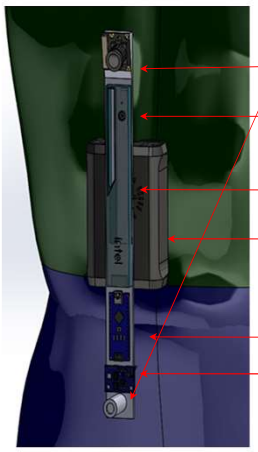


Turning with navigation information

SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

23

Capturing environmental cues



Sensor system

Line laser scanner

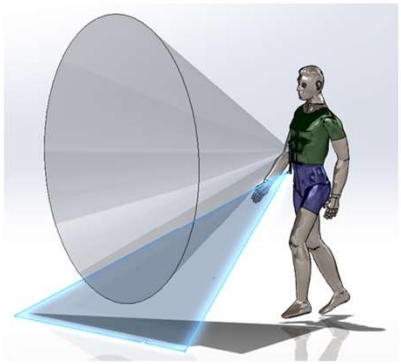
RGB-D camera-Realsense R200
(for T4.2)

Bluetooth

Raspberry Pi and UP Board controllers
(using ROS – Robot Operating System)

Arduino controller

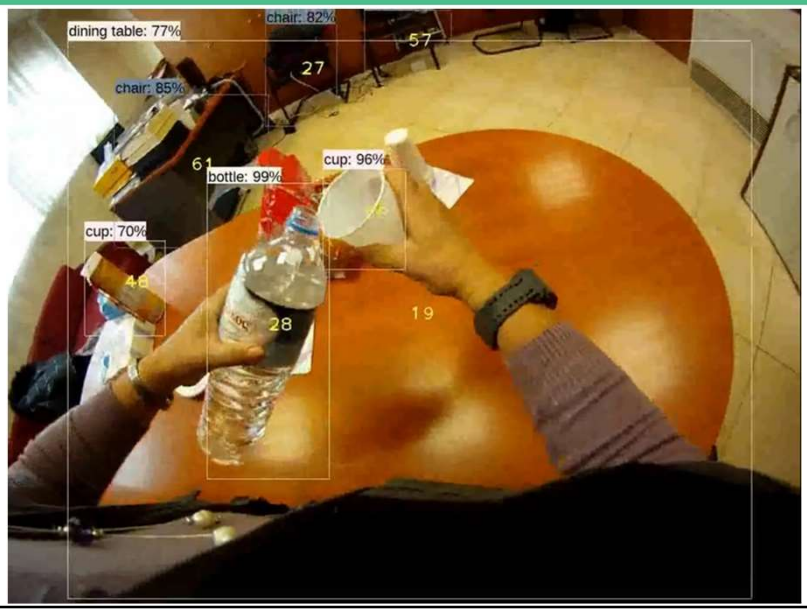
Inertial measurement unit(IMU)



SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

24

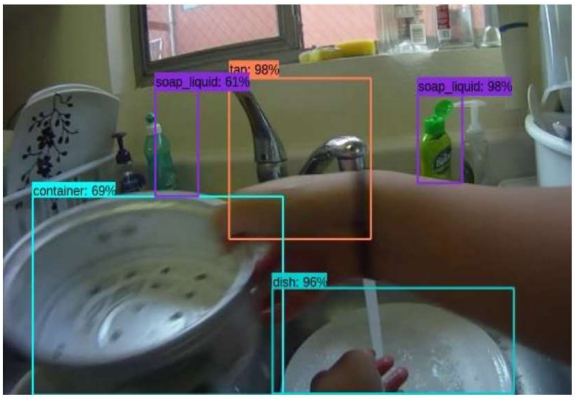
Real-time Object Detection & Recognition



SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

25

Real-time Object Detection & Tracking

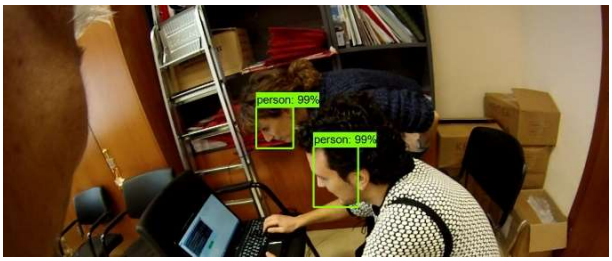


cell phone	tv remote	towel	door	pan	knife/spoon/fork
oven/stove	washer/dryer	vacuum	detergent/soap	tv	pills
water tap	fridge	blanket	microwave	container	food/snack
book	mug/cup	toothbrush	tooth paste	dish	comb
laptop	pitcher	trash can	kettle	bottle	person

SUITCEYES

26

Face Detection

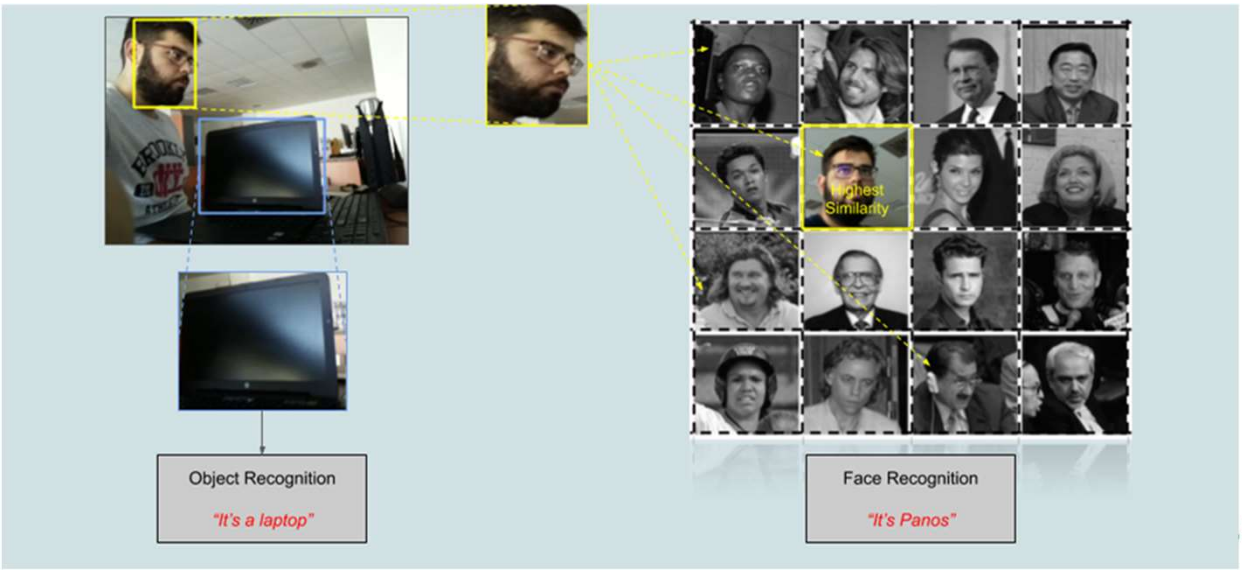


Similar to object detection but with a different model.

SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

27

Face Recognition



28

Scene Recognition

Prediction: bathroom, Confidence: 41%

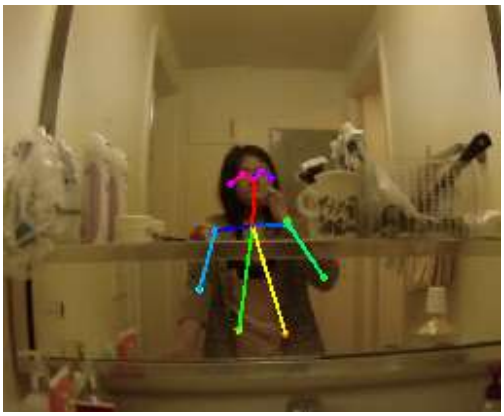
Prediction: closet, Confidence: 6%

Recognition of indoor spaces (e.g. bathroom, living room, etc)

SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

29

Activity Recognition

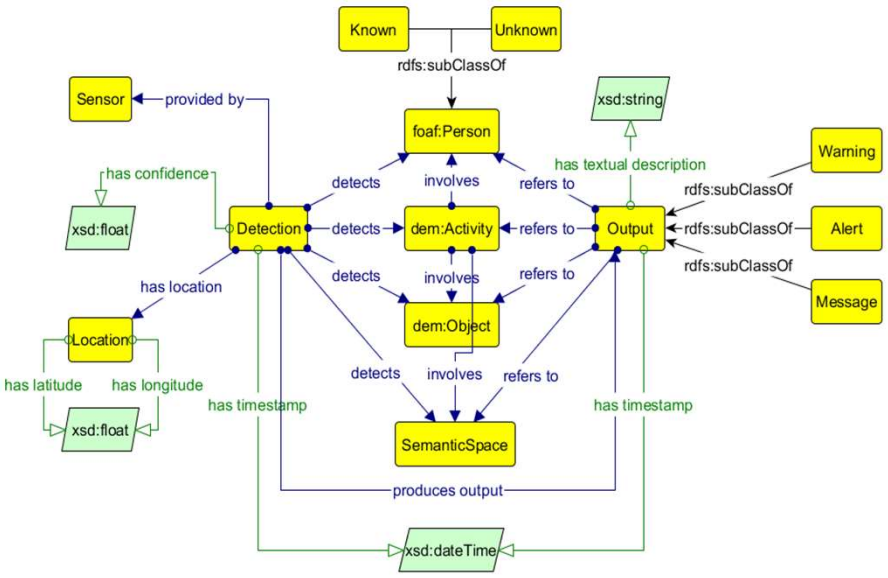


Third person gestures

SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

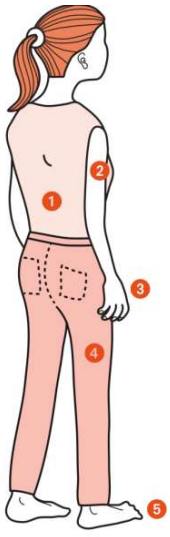
30

Overview of the Core Concepts



SUITCEYES

Semantic Representation & Reasoning



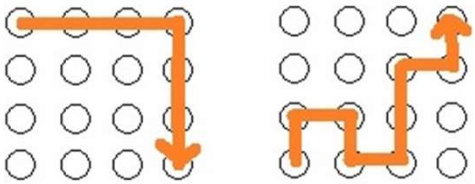
1 Back
2 Arm
3 Hand
4 Leg
5 Foot

Car
Good night

Blue

SUITCEYES

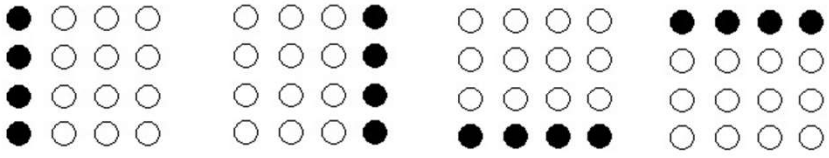
Over e.g. a 4 x 4 grid, we could emulate haptices (pictograms)



SUITCEYES

33

Sample Static Haptograms

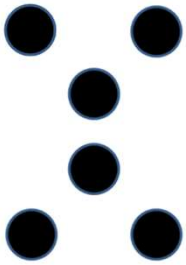


SUITCEYES

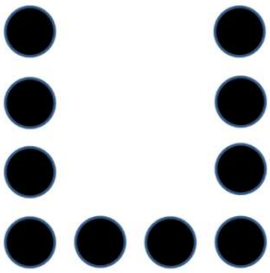
34

Sample Static Haptograms

"unknown person"



"at/by"

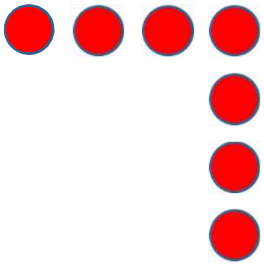


SUITCEYES

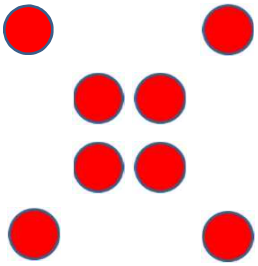
35

Dynamic haptograms as sequenced dot (actuator) patterns

"stand"



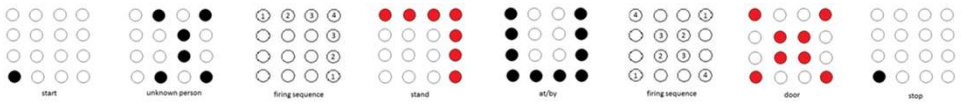
"door"



SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

36

Sample Statement Constructed from Static and Dynamic Haptograms over a 4 x 4 Actuator Grid



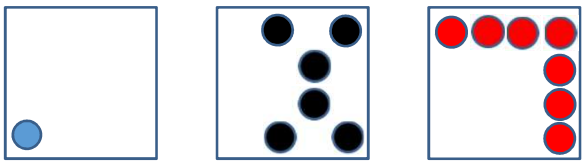
"Unknown person stand(ing) at/by (the) door".

Static haptograms are shown in black, dynamic ones in red.

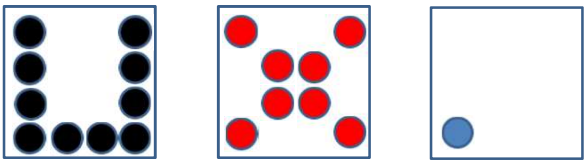
SUITCEYES

37

Same sample statement as sequenced dot (actuator) patterns



START "unknown person" "stand"

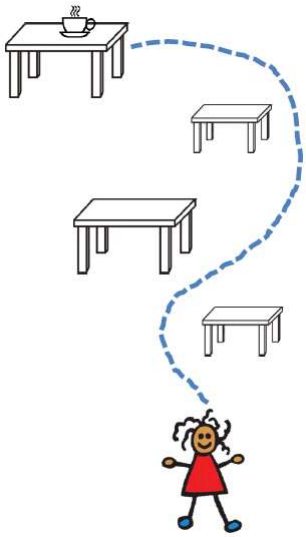


"by/at" "door" STOP

SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

38

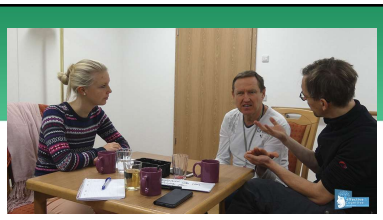
Joyful learning and life experiences



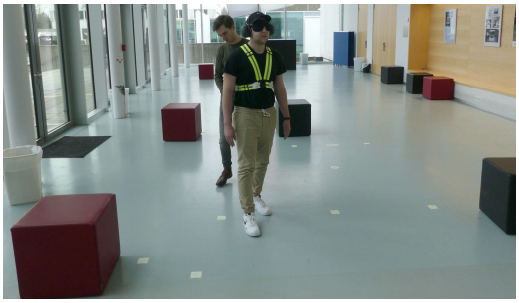
SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

39

Scenarios for Gamification, Experience Enrichment and Social Interaction



- **Concept for social, gamified scenarios**



10 gamified scenarios for enriching experience / enhancing social interaction

- Tailored to individuals with deafblindness (adapted / new concepts)
- Games for learning / training skills (e.g. navigation)
- Games for fun

Ranked by cognitive & technological requirements and level of physical activity

40

Other ?

- User study – **81** interviews with**79** participants in **5** countries
- Policy study – related policies in Sweden, UK, NL, Germany and Greece
- Publications
- Press
- Network

➢ Co-construction/ co-design

SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

Connect with us…

We welcome new connections and potential collaborations!!

SUITCEYES
AFFORDING INTELLIGENT HAPTIC COMMUNICATION

SUITCEYES

Nasrine.Olson@hb.se

www.suitceyes.eu

43

Thank you!

44