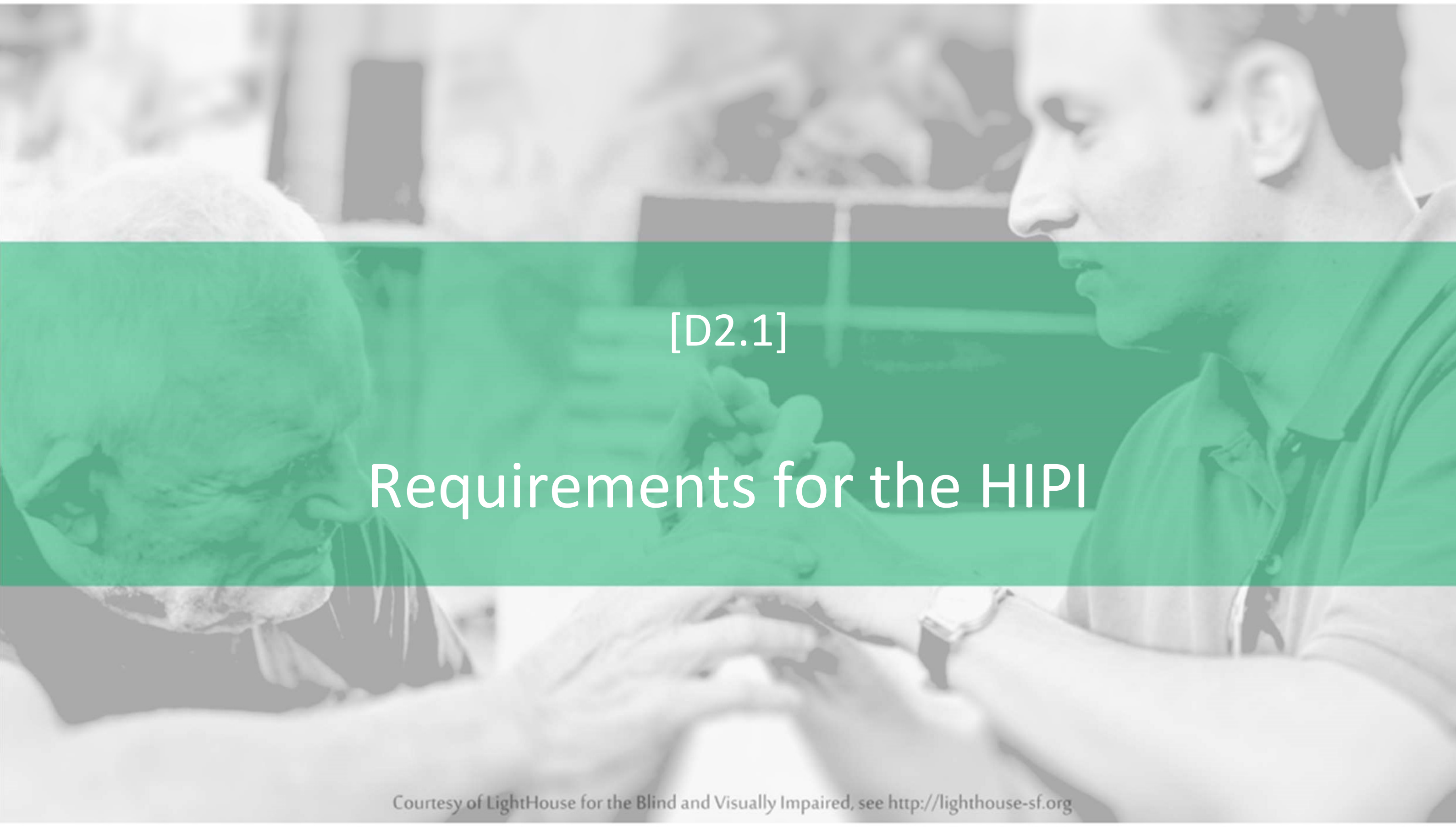
SUITCEYES

1 Jan 2018 - 31 Dec 2020

Smart, User-friendly, Interactive, Tactual, Cognition-Enhancer, that Yields Extended Sensosphere
Appropriating sensor technologies, machine learning, gamification and smart haptic interfaces



[D2.1]

Requirements for the HIPI

Courtesy of LightHouse for the Blind and Visually Impaired, see http://lighthouse-sf.org

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CO	CONFIDENTIAL, restricted under conditions set out in Model Grant Agreement	
CI	CLASSIFIED, information as referred to in Commission Decision 2001/844/EC.	

Deliverable Type		
R	Document, report (excluding the periodic and final reports)	X
DEM	Demonstrator, pilot, prototype, plan designs	
DEC	Websites, patents filing, press & media actions, videos, etc.	
OTHER	Software, technical diagram, etc.	

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Glossary	
Abbr./ Acronym	**Meaning**
HIPI	Haptic Intelligent Personalised Interface – the haptic feedback system to be developed through the SUITCEYES project.

Table of Contents

Executive Summary

This deliverable outlines the requirements for the Haptic Intelligent Personalised Interface (HIPI), which the system must satisfy in order to be acceptable to its intended users. The emphasis here is on broad requirements as a prerequisite for the more detailed technical specifications that will follow this deliverable. The requirements outlined here will also be used as a means of evaluating the HIPI during development and the final stages.

This deliverable draws on information from a number of sources:

- Interviews with potential users of the technology (persons with deafblindness)
- Interviews with experts who work with people with deafblindness
- Interviews with family members of people with deafblindness
- ISO standards for haptic and tactile interactions
- Expert advice from the SUITCEYES project advisory group
- Previous research and literature supporting the development of the project

Although a small percentage of the population, people with deafblindness are a very diverse group of people in terms of characteristics and technological needs. This diversity establishes a basic requirement for the development of technology that is flexible and can be personalised according to individual requirements.

The general high level needs identified in this report from interviews with persons with deafblindness concern the overall aspirations of the studied population in regard to independent daily living, with the addition of the need for more specific access to technology and personal assistance. For more detailed reporting on the results of interviews with people with deafblindness, personas and scenarios, please see D2.2.

The SUITCEYES project has a defined scope of haptic communication and navigation, established via a thorough review of relevant literature and research prior to the funding application. This focus is broad enough for the HIPI to have the potential to contribute to meeting the needs and requirements of users as identified through interviews.

ISO 92410 Parts 910 and 920, respectively, provide a framework for and guidance on haptic and tactile interactions. These are detailed in Appendix 2 as they relate to work on developing the HIPI. Notable points are: the importance of user control of and ability to adjust the HIPI, comfort of use and the importance of not putting users in the position of increased risk of harm.

Regulation is a fast moving area and further standards are under development at the time of writing this report. The JTC 1/SC 42 initiative on artificial intelligence is an example of this. We will keep the situation under active review and seek to contribute to such developments where possible.

We outline six principles as the basis for HIPI requirements, as follows:

- **Principle 1:** *The HIPI should be a platform, not a product*

- **Principle 2:** *The HIPI must be capable of reliably detecting information about the physical surrounding environment beyond arm's reach*
- **Principle 3:** *The HIPI should not prevent the use of the hands for other activities during use*
- **Principle 4:** *The HIPI must be capable of delivering information about the physical surroundings to the user through haptic media.*
- **Principle 5:** *The HIPI must be capable of delivering semantic content to the user through haptic media.*
- **Principle 6:** *The HIPI must not unnecessarily duplicate the functions of already available devices but should have the potential to work together with them*.

A more detailed account is provided below in the main report, which concludes with a final summary of requirements.

Introduction

This deliverable outlines the requirements for the Haptic Intelligent Personalised Interface (HIPI), which the system must satisfy in order to be acceptable to its intended users. These serve both as a guide for technical development, and as a basis for iteration and evaluation of the HIPI during its development and in the final stages of the project. The emphasis in this document is on high level user needs and requirements for the HIPI as a whole, rather than detailed technical requirements for specific subsystems.

In line with ISO 9241-210 (Human-centred design for interactive systems), the development of the HIPI should be based upon a detailed understanding of user needs. Requirements are therefore based principally upon the user needs identified in the Work Package 2 User Interviews, which are reviewed in Section 3 of this report and in more detail in Deliverable 2.2. Of course, not all user needs will be addressable in the scope of the SUITCEYES project, or best addressed by the proposed HIPI. Rather than selectively reporting only those needs most relevant to the project, in Section 2 we consider the appropriate scope of requirements. We also recognise that other stakeholders, such as family members and carers also have legitimate needs and priorities but recognise it may not be possible to meet all of these in the scope of this project. We also consider these in Section 2. The appropriate purview of the HIPI is determined in relation to the description of action of the project, and discussions with project advisory board.

Section 3 then provides as a full a picture as possible of the identified user needs based upon the interviews conducted at the time of writing.

Section 4 highlights key requirements that can also be considered from ISO 9241 Parts 910 and 920 (Framework and Guidance for Tactile and Haptic Interactions), and Section 5 provides the table of requirements resulting from this process.

Purpose and Scope of the HIPI

People with Deafblindness

Our and previous research[1] with persons with deafblindness as well as discussions with the SUITCEYES Project Advisory Board highlights that people with deafblindness are a very diverse group and therefore a wide range of technological devices or interventions may be of benefit to them.

The number of deafblind people is small, at between 0.2% and 2% of the worldwide general population[2], although definitions and therefore numbers vary. Most people with deafblindness have some residual sight and hearing, which can differ greatly from one individual to another, and most rely strongly on these residual senses.

The progression of deafblindness (for example, whether a person has congenital deafblindness, is a blind person who develops a hearing impairment or is a deaf person who develops a visual impairment, becoming deafblind in later life), can have a huge impact on the capacities an individual has, the strategies they use and the level of assistance they require. Add to this individual variation in stage of the life course, tastes, interests, environment, and social relationships, and it is clear that the needs of people with deafblindness can vary hugely. This makes it not very meaningful to identify a single scenario that is universal to individuals with deafblindness, and it follows that the ability to adapt equipment to the needs of individuals is very important. For the purpose of the SUITCEYES project, it is necessary to focus on a limited selection of use cases, but the discussion above does highlight that any platform and / or device developed should not be limited to a single use case but should ideally be extensible and adaptable to other use cases.

The Scope of the SUITCEYES Project

Nevertheless, the SUITCEYES project has a defined scope - that of haptic communication and navigation - and any devices or solutions developed in the course of the project need to fall within this. The description of action for the SUITCEYES project lays out four user-oriented objectives, 2 RTD objectives and 2 societal objectives, as follows:

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[1] See for example: Dammeyer,J. (2014) Deafblindness: a review of the literature, in *Scandianavian Journal of Public Health,* 42 (7) 554-562; Hersh, M. (2013) Deafblind people, communication, independence, and isolation, in *Journal of deaf studies and deaf education* 18(4) 446-463; Jaiswal, A., Aldersey, H., Wittich, W., Mirza, M. and Finlayson, M. (2018) Participation experiences of people with deafblindness or dual sensory loss: A scoping review of global deafblind literature, *PLoS 1* (13(9) e0203772.

[2] World Federation of the Deafblind (2018) *At Risk of Exclusion from CRPD and SDGs Implementation: Inequality and Persons with Deafblindness* http://www.internationaldisabilityalliance.org/sites/default/files/wfdb_complete_initial_global_report_september_2018.pdf

User oriented Objective #1 (UO1): To extend users' independent perceptions of the physical surrounding environment.
User oriented Objective #2 (UO2): To extend users' communication capabilities by facilitating communication or extending the range of haptic vocabulary at their disposal.
User oriented Objective #3 (UO3): To facilitate learning and extend fun life experiences through gamification and affective computing
User oriented Objective #4 (UO4): To improve the circumstances in which the users find themselves.
RTD Objective #1 (RTD-O1): To develop a haptic interface for informing of the physical surrounding environment.
RTD Objective #2 (RTD-O2): Capturing, translating and semantically representing environmental cues.
Societal Objective #1 (SO1): To identify and raise awareness of the priorities and aspirations of participating deafblind people for leading active and fulfilling lives, and the barriers to achieving these.
Societal Objective #2 (SO2): To identify good practice in policy frameworks across the participating countries and make recommendations for where policy could be improved.

Not all of these objectives are relevant in the same way with regard to the functions to be performed by the HIPI: UO4, SO1 and SO2 are objectives that do not require any technical functions or impose constraints upon the HIPI beyond requiring that it respond to identified user needs and that the HIPI should make a positive contribution to personal circumstances. However, it should not increase the likelihood that users will be seen negatively, for example, by making people appear different, strange, or even threatening, to casual observers. Whenever possible, it should increase the likelihood that other people will view the user with deafblindness in a positive light and react more positively to them. These requirements may have implications for non-functional technical design.

Taken together and linked with other sources of expert information, these imply several principles that should be considered in setting requirements.

Principle 1: *The HIPI should be a platform, not a product (Project Advisory Board).* The HIPI should be a platform for further development, that can be adapted and extended in the future, rather than a dedicated product for a single set of uses. The ability to add additional components, such as sensors and reconfigure the haptic signals to suit individuals' needs will be an important part of making the HIPI a useful device.

Principle 2: *The HIPI must be capable of reliably detecting information about the surrounding physical environment beyond arm's reach. (UO1, RTD-01).* To satisfy UO1 and RTD-01, the HIPI should be able to sense things about the environment that the user could not already do, by, for example, using their hands.

Principle 3: *The HIPI should not prevent the use of the hands for other activities during use* (UO1, UO2). As the goal is to extend the capabilities of the user, restricting the use of the hands for exploration or communication would be counterproductive. Accordingly, the HIPI should ideally leave the hands free, except when the user explicitly wishes to control the device (for example, operating controls on it).

Principle 4: *The HIPI must be capable of delivering information about the physical surroundings to the user through haptic media. (UO1, RTD-02).* Detected information is only valuable if it (or information derived from it) is conveyed to the user, and as the HIPI is, by definition, for haptic communication, this must be in a haptic form.

Principle 5: *The HIPI must be capable of delivering semantic content to the user through haptic media. (UO2).* This overlaps with Principle 2, but explicitly requires that information can be structured into a message - rather than delivering a simple alert, or indication of distance, there should be some capacity to put signals together into a form of message.

Principle 6: *The HIPI must not duplicate the functions of already available devices*. (UO1, UO2). As the aim is to extend existing capabilities, the HIPI should aim to complement rather than replace existing technologies: it should avoid replicating functions or devices that already exist. At the same time, it should be possible to integrate functions of other so that users do not have to carry multiple devices.

User Needs as Identified from Interview Data

We understand the needs of disabled people and people with deafblindness as being fundamentally the same as for all people and not as simply deducible from impairment. In this section we begin with a broad account of overall user needs that is rooted in the data from interviews with people with deafblindness, their close associates and experts. This provides an overall direction for product development because it allows a focus on the reasons why the HIPI might be actually used and the social and environmental contexts of use.

Methods used for interviewing people with deafblindness are described in the Deliverable 2.2 Personas, scenarios and use environments and elements of good practice in interviewing people with deafblindness are discussed in Deliverable 2.3. However, in Appendix 1 of this report we include some details regarding attributes of interviewees that can be cross referenced with D2.2 data.

We have identified themes from 81 detailed interviews with 79 potential users in five countries: Germany, Greece, the Netherlands, Sweden and the UK. Participants highlighted the following overall issues:

- The importance of getting out and about and taking an active part in life;
- The importance of social relationships with friends, family and acquaintances for personal wellbeing;
- The value of reciprocal and equal relationships with others and participation in a wide range of activities as the basis for this;
- The need for guide interpreters and personal assistance;
- The value of doing things on one's own and to have privacy;
- The need to make a contribution to society;
- The importance of work, for money, meaningful activities and work relationships;
- The requirement for robust devices that cannot be easily stolen, broken or misplaced;
- The need for accurate information about latest technical devices, new opportunities and costs;
- The need for access to affordable devices;
- The importance of not being singled out as negatively different e.g. through looking strange or supported in a way that is inconvenient to the general public; and
- The value of new games, especially those that can be played with children, friends and family members.

As stated above, the HIPI will not be able to address all of the needs of persons with deafblindness but at the very least it should not impair them – for example, it should not aim to reduce social contact by supplanting carers or be incapable of functioning in typical settings used by the general population.

Functions that the HIPI should perform

In D2.2 we provided a synthesis of the main user priorities identified by SUITCEYES participants, ranked by the number of times they were mentioned. These are summarised again below, now with functions identified in the column on the right.

ACTIVITY	FUNCTIONS
Finding way around outside, including familiar and unfamiliar routes	Object and person recognition, communication of location, detection of free space around the user, locate where and how to change direction more accurately than Google maps
Better communication with other people – more people and more opportunities	Person recognition, ability to send haptic signals conveying meaning, compatibility with a range of communication devices that can be used in group situations and over distance.
Finding way around unfamiliar rooms and identifying objects	Object recognition, identification of space and layout
Gaining a picture of the whole environment	Identify important features about the scene and changes in the environment
Using public transport (especially trains)	Object recognition, ability to at least assist in complex and / or busy environments, identify additional sources of help
To recognise people who come to the door or are in the house	Person recognition, location of persons
To recognise important things in the home, e.g. labels on food items, receive warnings about taps or cookers left on	To communicate or link to a device that can read food labels, to be able to warn the user about safety concerns in the home.
To do exercise – various kinds, with various people	Object and person recognition. Able to communicate direction or other key information as needed by the activity
Playing games with other people	Object recognition, customisation of games and development of new games that can work with the HIPI
Finding lost items in the house	Object recognition, location through tagging
Recognising people on the street, sometimes	Person recognition that can be turned on and off.

Our interviews with people with deafblindness have shown that many use additional aids, such as guide dogs, canes and smartphones as well as many others. Therefore, the HIPI must be controllable by the user, who should be able to switch various functions on and off. The ability to link the HIPI to other devices would also be a useful feature.

International Standards

ISO 92410 Parts 910 and 920, respectively, provide a framework for and guidance on haptic and tactile interactions. These cover all applications of haptic and tactile interaction (including haptic feedback in human computer interaction, and virtual reality), so not every recommendation is applicable to the context of the HIPI. Nevertheless, a review of these two documents highlighted a number of key points for requirements. These are included in detail in Appendix 2. Key points from these standards were the need to make allowance for the ability of different users to discriminate signals (which may vary significantly), both in terms of intensity, space and time; the ability of the user to control and interact with the system, including the ability to identify what mode it is in; as well as factors such as comfort, the weight of the device, and fundamental safety features such as protection from electrical or mechanical injury, or the accumulation of heat.

Requirements

Based on the above, the following requirements have been identified for the HIPI. We recognise that some functions present considerable challenges and may not be immediately achievable, such as the capability of operating in busy environments. However, we include these as desirable because they are important areas of difficulty for potential users.

ID	Description	Priority	Source
1.	The HIPI should be reconfigurable, and able to accommodate future extension to additional sensors or modes of feedback.	Critical	Principle 1
2	It should be possible for sensor layout and haptic feedback to be configured to the needs of individual users.	Critical	Principle 1, ISO Standards
3	Signals used by the HIPI must be reliably discriminable by the intended user.	Critical	ISO Standards
4	The HIPI should be able to deliver haptic feedback without requiring continuous use of the hands.	Desirable	Principle 3
5	The HIPI must be capable of detecting information from the environment at a range of at least 1m.	Critical	Principle 2
6	The HIPI must not increase the level of risk involved in the context in which it will be used.	Critical	ISO Standards
7	The HIPI must be capable of delivering information to the user through haptic media.	Critical	Principles 4 & 5
8	The user should be able to control when the HIPI is on and what functions it performs.	Critical	ISO Standards
9	The HIPI must be comfortable to use, and not cause fatigue.	Critical	ISO Standards
10	The HIPI should not cause an unacceptable level of noise.	Critical	ISO Standards
11	The user should be able to safely disengage from the HIPI at any time.	Critical	ISO Standards
12	The HIPI should not impair the users' ability to carry out tasks.	Desirable	User Interviews

ID	Description	Priority	Source
13	The HIPI should be robust to loss, damage or theft.	Desirable	User Interviews
14	The HIPI should be affordable to its intended users.	Critical	User Interviews
15	The HIPI should not impair or reduce social contact for its users.	Critical	User Interviews
16	The HIPI should not introduce new constraints upon the tasks a user can undertake: it should increase, rather than reduce options.	Critical	User Interviews
17	The HIPI should include the capability to capture images for object and person recognition.	Critical	User Interviews
18	The HIPI should be able to determine its location in the environment, for example by identifying rooms in a building.	Desirable	User Interviews
19	The HIPI should be able to identify collision risks and help the user to avoid them.	Critical	User Interviews
20	The HIPI should allow the user to send and receive haptic signals to other users.	Desirable	User Interviews
21	The HIPI should be compatible with existing assistive devices as far as possible.	Desirable	User Interviews
22	The HIPI should be able to function correctly in busy environments, to the extent possible.	Desirable	User Interviews

Appendix 1 Participant Characteristics

Demographic Data	Age	Country	Gender	Impairment	Living Arrangements	Occupation
Anne Assistant	40-49	Germany	Female	Deaf then Blind	On Own	Employed as Assistant
Bärbel	50-59	Germany	Female	Deaf then Blind	With Family/Friends	Unassigned
David Assistant	30-39	Germany	Male	Not Applicable	Unassigned	Employed as Assistant
Dieter	50-59	Germany	Male	Deaf then Blind	Sheltered Housing	Unemployed
Ellen Assistant	50-59	Germany	Female	Not Applicable	Unassigned	Employed as Assistant
Felix	50-59	Germany	Male	Congenital	Sheltered Housing	Voluntary Work
Günther	60-69	Germany	Male	Deaf then Blind	Sheltered Housing	Unassigned
Hannelore	70+	Germany	Female	Deaf then Blind	Sheltered Housing	Retired
Herbert	50-59	Germany	Male	Deaf then Blind	Sheltered Housing	Unemployed
Jakob	50-59	Germany	Male	Deaf then Blind	Sheltered Housing	Voluntary Work
Klara Assistant	50-59	Germany	Female	Not Applicable	Unassigned	Employed as Assistant
Matthias	40-49	Germany	Male	Deaf then Blind	With Family/Friends	Employed
Michael	30-39	Germany	Male	Deaf then Blind	On Own	Education
Rudolf	40-49	Germany	Male	Deaf then Blind	Sheltered Housing	Employed
Sebastian	50-59	Germany	Male	Deaf then Blind	With Family/Friends	Voluntary Work
Herbert	60-69	Greece	Male	Deaf then Blind	Sheltered Housing	Retired
Viktoria	30-39	Greece	Female	Blind then Deaf	Sheltered Housing	Unemployed
Sonia	40-49	Greece	Female	Deaf then Blind	With Family/Friends	Employed
Felix	50-59	Greece	Male	Deaf then Blind	On Own	Employed
Nina	40-49	Greece	Female	Deaf then Blind	With Family/Friends	Employed
Christine	50-59	Greece	Female	Deaf then Blind	With Family/Friends	Unemployed
Karen	50-59	Greece	Female	Deaf then Blind	With Family/Friends	Unemployed
Alfonso's mother	30-39	Greece	Female	Congenital	With Family/Friends	Unemployed
Dan	60-69	Greece	Male	Blind then Deaf	On Own	Retired
Katia	40-49	Greece	Female	Blind then Deaf	On Own	Unemployed
Viktor	30-39	Greece	Male	Blind then Deaf	Sheltered Housing	Unemployed
Henrick	30-39	Greece	Male	Blind then Deaf	With Family/Friends	Employed
William	60-69	Greece	Male	Blind then Deaf	With Family/Friends	Unemployed
Ruben's mother	30-39	Greece	Male	Congenital	With Family/Friends	Unemployed
Nicole	20-29	Greece	Female	Congenital	With Family/Friends	Education
Berta	50-59	Greece	Female	Deaf then Blind	With Family/Friends	Unemployed

Phil's wife	50-59	Greece	Male	Deaf then Blind	With Family/Friends	Unemployed
Deziree	20-29	Greece	Female	Deaf then Blind	With Family/Friends	Employed
Niko	40-49	Netherlands	Male	Deaf then Blind	On Own	Employed
Carel	40-49	Netherlands	Male	Blind then Deaf	On Own	Unemployed
Anna	60-69	Netherlands	Female	Deaf then Blind	With Family/Friends	Retired
Jane	60-69	Netherlands	Female	Deaf then Blind	With Family/Friends	Voluntary Work
Kees	50-59	Netherlands	Male	Deaf then Blind	On Own	Voluntary Work
Lara	40-49	Netherlands	Female	Deaf then Blind	With Family/Friends	Voluntary Work
Marc	60-69	Netherlands	Male	Deaf then Blind	On Own	Voluntary Work
Olga	60-69	Netherlands	Female	Deaf then Blind	With Family/Friends	Retired
Barry	60-69	Netherlands	Male	Blind then Deaf	With Family/Friends	Retired
Dirk	30-39	Netherlands	Male	Deaf then Blind	On Own	Voluntary Work
Evert	50-59	Netherlands	Male	Blind then Deaf	With Family/Friends	Voluntary Work
Fleur	50-59	Netherlands	Female	Deaf then Blind	With Family/Friends	Unemployed
Geert	20-29	Netherlands	Male	Deaf then Blind	With Family/Friends	Employed
Hanneke	50-59	Netherlands	Female	Deaf then Blind	On Own	Employed
Ian	60-69	Netherlands	Male	Deaf then Blind	With Family/Friends	Retired
Store	Unassigned	Sweden	Male	Not Applicable	Unassigned	Employed as Expert
David	50-59	Sweden	Male	Deaf then Blind	With Family/Friends	Employed
Monika	40-49	Sweden	Female	Deaf then Blind	On Own	Employed
Ansel	60-69	Sweden	Male	Blind then Deaf	On Own	Employed
Iris	40-49	Sweden	Female	Blind then Deaf	On Own	Unemployed
Emilie	50-59	Sweden	Female	Deaf then Blind	On Own	Unemployed
Joseph	70+	Sweden	Male	Deaf then Blind	On Own	Retired
Daniel	40-49	Sweden	Male	Deaf then Blind	With Family/Friends	Retired
Irene	60-69	Sweden	Female	Deaf then Blind	With Family/Friends	Employed
Vika	40-49	Sweden	Female	Deaf then Blind	With Family/Friends	Employed
Maria	50-59	Sweden	Female	Not Applicable	Living with husband who is deafblind	Employed as Expert
Jenny	50-59	Sweden	Female	Not Applicable	Unassigned	Employed as Expert (area of expertise: congenital deafblindness)
Åse	50-59	Sweden	Female	Not Applicable	Unassigned	Employed as Expert (also mother of a daughter with congenital deafblindness)

Ann-Sofie	40-49	Sweden	Female	Not Applicable	Unassigned	Employed as Expert
Annabel	70+	UK	Female	Deaf then Blind	With Family/Friends	Retired
Benjamin	50-59	UK	Male	Blind then Deaf	On Own	Employed
Bob	30-39	UK	Male	Deaf then Blind	With Family/Friends	Education
Brenda	30-39	UK	Female	Blind then Deaf	With Family/Friends	Employed
Cathy	20-29	UK	Female	Congenital	Sheltered Housing	Voluntary Work
Emma	70+	UK	Female	Deaf then Blind	On Own	Retired
Holly	60-69	UK	Female	Blind then Deaf	With Family/Friends	Voluntary Work
Katy	40-49	UK	Female	Blind then Deaf	With Family/Friends	Employed
Linda	70+	UK	Female	Deaf then Blind	With Family/Friends	Retired
Mohammed	Under 20	UK	Male	Deaf then Blind	With Family/Friends	Education
Nancy	30-39	UK	Female	Deaf then Blind	On Own	Voluntary Work
Peter	30-39	UK	Male	Blind then Deaf	With Family/Friends	Employed
Rosie	50-59	UK	Female	Blind then Deaf	On Own	Employed
Sheila	20-29	UK	Female	Blind then Deaf	With Family/Friends	Voluntary Work
Susan	50-59	UK	Female	Deaf then Blind	On Own	Retired
Theresa	40-49	UK	Female	Deaf then Blind	On Own	Unemployed
Patrick	20-29	UK	Male	Blind then Deaf	With family	Employed

Appendix 2: ISO Standards

This section highlights the main pieces of guidance identified from ISO 92410-910 and 920, summarised in the following table with their Implications for the HIPI.

Source	Guideline	Implications for HIPI
ISO 92410-910, 6.2.2.1	Logical space should be modality free.	This is important if we are to maintain the adaptability and individualisation recommended by the SUITCEYES advisory board in this case. The way in which the HIPI structures and processes information should be independent of the method used to deliver it to the user.
ISO 92410-910, 6.3.1	Addressability and resolution should be considered in the design of tactile/haptic interactions.	Signals sent by the HIPI need to take account of the resolution of signals in a given modality that a user can reliable distinguish – and this may be different for different individuals.
ISO 92410-910, 9.2.12.1	The acoustic noise of a device should be considered when choosing a tactile/haptic device.	Actuators are rarely silent, and the HIPI should not provide so much noise that it is disturbing or interferes with people beyond the user, or interferes with the user's residual hearing.
ISO 92410-910, 9.2.12.2	The weight of the device that might have to be transported in the task should be considered.	The weight of the HIPI should be low enough that users can carry it conveniently, and without risk of injury.
ISO 92410-910, 9.2.13.1.1	Mechanical safety of the device should be considered.	The HIPI should not present a risk of mechanical injury from the actuators used to provide haptic feedback.
ISO 92410-910, 9.2.13.1.2	The risk of actuators propelling parts of the device into violent contact with a user should be avoided or reduced.	
ISO 92410-910, 9.2.13.1.3	Ways of shutting down the device when not in use should be considered.	It should be possible to shut the HIPI down when not in use.
ISO 92410-910, 9.2.13.1.4	The user of the device should be able to disengage from the device.	It should be possible (and easy) for the use of the HIPI to disengage from it.

ISO 92410-910, 9.2.13.2.2	It should be ensured that the user of the device is shielded from dangerous electrical voltages.	The HIPI should not expose the user to dangerous electrical voltages.
ISO 92410-910 9.2.13.2.4	If electrical power fails, the device should enter a safe state.	The HIPI should enter a safe state if electrical power fails. A corollary to this is that users should not be left in a dangerous situation if power to the HIPI fails.
ISO 92410-910, 9.2.13.3	The thermal safety of the device should be considered when choosing a tactile/haptic device.	The HIPI should not expose the user to risk of injury or discomfort as a result of heat accumulation, whether from haptic displays (such as peltier modules) or accumulation of heart within the electronics or mechanisms of the HIPI.
ISO 92410-910, 9.2.15.1	Modification of the device required by the task should be considered.	The HIPI should be modifiable to meet the needs of different users.
ISO 92410-910, 9.2.15.2	Special control of the device appropriate to the task should be considered.	The HIPI user should be able to control its functions, and select when (and if appropriate, how) information should be presented.
ISO 92410-920, 3.1.3	The system should provide a context to help the user to understand the meaning of the tactile/haptic perception and the environment or program.	The HIPI should provide ways for the user to identify what mode it is in, and what information is being presented. This may be trivial (as in an application where the HIPI has only mode, and presents only a single piece of information when it is active).
ISO 92410-920, 3.1.5	The system should provide information that allows the user to know which task or function is active.	
ISO 92410-920, 3.1.6	The system should: a) ensure user comfort over extended periods of time, and b) avoid or minimise user fatigue.	The HIPI should not cause user fatigue and should remain comfortable over the duration of its use.
ISO 92410-920, 3.1.11	The system should prevent unintended effects on non-activated interface elements due to the activation of a nearby interface element.	The HIPI should prevent unintended activation of elements. The limited means for giving status feedback make this particularly important.

ISO 92410-920, 3.2.3	Options to adjust tactile/haptic parameters should be provided to prevent discomfort, pain or injury to users of interactive systems.	There should be capacity to customize the display of information to the intended user.
ISO 92410-920, 3.3.3	The system should minimise the effects of sensory adaptation to vibration.	The HIPI needs to prevent sensory adaptation, where prolonged exposure to a stimulus changes the perception of it.
ISO 92410-920, 3.3.3	The system should enable the user to recover from sensory adaptation to stimuli.	
ISO 92410-920, 3.3.5	The system should minimise unintended perceptual illusions.	The HIPI should avoid creating unintended perceptual illusions.
ISO 92410-920, 4.1.1	Where available, well-known tactile/haptic patterns, which are familiar in daily life, should be used for presenting information.	The HIPI should use tactile or haptic patterns already known to the user, where possible.
ISO 92410-920, 4.1.2	Where possible, tactile/haptic encodings should be made obvious to the users by ensuring cues are a) simple and intuitive, an b) easy to learn and discriminate between.	Where existing tactile signals are not available, the HIPI should use intuitive encodings as far as possible.
ISO 92410-920, 4.2.3	Unless proven that a user can discriminate between a large number of values, the number of values used for encoding a single attribute should be limited to three that are significantly different from one another.	The HIPI should not use more than three levels for any given stimulus, unless proven otherwise useful.