The XXR Tool: appendix

A graduation appendix by Wo Meijer

90X: Appendices

900 Appendix 0: Graduation Proposal

DESIGN FOR our future

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IDE Master Graduation
Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME
Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name	Meijer
initials	WIMT
given name	Wouter
student number	4221044
street & no.	Juniusstraat 61
zipcode & city	2526XZ Delft
country	Netherlands
phone	+31639630515
email	womeijer@gmail.com

Your master programme (only select the options that apply to you):

IDE master(s): ( ) IPD   ( ) DfI   ( ) SPD

2nd non-IDE master: _____

individual programme: _____ - _____ (give date of approval)

honours programme: ( ) Honours Programme Master

specialisation / annotation: ( ) Medisign

( ) Tech. in Sustainable Design

( ) Entrepeneurship

SUPERVISORY TEAM **
Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair	Song, Y.	dept. / section:	DE Mechatronic Design
** mentor	Ozcan Vieira, E.	dept. / section:	ID Design Aesthetics
2nd mentor			
	organisation:		
	city:	country:	
comments (optional)			

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

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APPROVAL PROJECT BRIEF
To be filled in by the chair of the supervisory team.

chair Song, Y.   date -   -   signature

CHECK STUDY PROGRESS
To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: _____ EC

Of which, taking the conditional requirements
into account, can be part of the exam programme _____ EC

○ YES   all 1st year master courses passed

○ NO   missing 1st year master courses are:

List of electives obtained before the third
semester without approval of the BoE

name _____   date -   -   signature _____

FORMAL APPROVAL GRADUATION PROJECT
To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

• Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
• Is the level of the project challenging enough for a MSc IDE graduating student?
• Is the project expected to be doable within 100 working days/20 weeks ?
• Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: ○ APPROVED   ○ NOT APPROVED

Procedure: ○ APPROVED   ○ NOT APPROVED

comments

name _____   date -   -   signature _____

Initials & Name WIMT   Meijer   Student number 4221044

Title of Project Augmented Reality Beyond Vision

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Personal Project Brief - IDE Master Graduation

Augmented Reality Beyond Vision

project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date   22 - 10 - 2018   09 - 05 - 2019   end date

INTRODUCTION **
Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

Augmented and Virtual Reality (sometimes jointly referred to as Mixed Reality) are the process of changing/replacing the 'reality' of a user with a manufactured one. An example of Virtual Reality is the PlayStation VR headset which uses a screen and headphones to take over the inputs for the user's sight and hearing, allowing it to project a virtual world.

Augmented Reality is distinct in that it does not replace all the input for the user's senses, but instead augments it. An example of this is the Measure, a program that runs on Android phones and overlays a measuring tape on the camera's view, allowing them to measure real world objects while looking at them through their phone.

Sensory substitution is the practice of using input for one sense to send other information through it. An example of this is shown in Fig.1 where a vest which embeds vibrator motors is used to translate sound into vibrations on a deaf person's back to argue the hearing sense. This practice is well studied in the neuroscience field where it is primarily used as an accessibility tool to help those lacking a sense make up for it.

Mobgen is a digital consulting company located in Amsterdam. As a consulting company they constantly research how they can push cutting edge technologies such as VR and AR in order to help improve their clients' products and business proposals. While their aim is not to create any device directly, they are interested in how to argue other senses that would unlock new opportunities and help differentiate their services and enhance the user experience of the products of their clients.

space available for images / figures on next page

Initials & Name   WIMT   Meijer   Student number   4221044

Title of Project   Augmented Reality Beyond Vision

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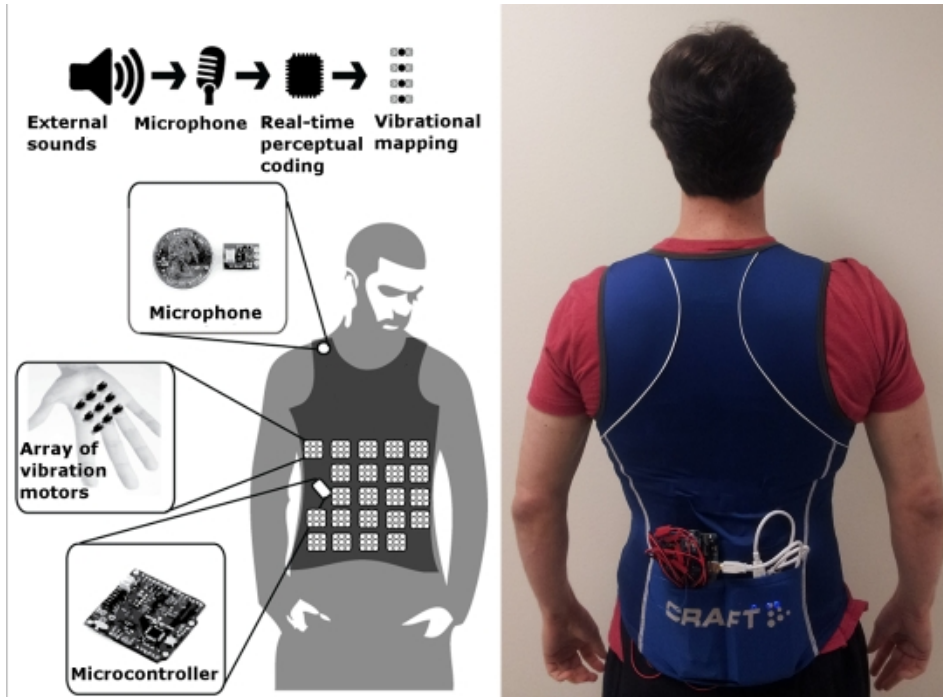introduction (continued): space for images

image / figure 1:   A vibration suit, an example of sensory substitution (Novich and Eagleman, 2015)

image / figure 2:   Tongue Display Unit (TDU) for "high definition electrostatic spatial information" (Kaczmarek, 2010)

PROBLEM DEFINITION **
Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

Augmented Reality and Virtual Reality are growing fields with a great amount of investment and potential. However, companies working on AR and VR projects currently limit themselves to sight and sound based implementations. While using other sense to communicate information is well known in neuroscience and the accessibility world, this knowledge has not been transferred to the consumer market.

This project aims to give designers and companies a 'map' for the development of AR and VR can be extended into senses beyond sight and sound. From this end, the project is a technologically pushed exploratory research into the senses and how to modify them. This is followed by the development of process for selecting sense based on objectives and context. In order to validate this process, it will be used in the development of Demonstrators.

ASSIGNMENT **
State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

RQ1) what can enhance user experience experience using additional sensory input(s) in AR and VR applications.
RQ2) how can these solutions be mapped out to enable designers to select fitting input(s).
RQ3) how can the previous discoveries be demonstrated with prototypes.

The primary starting focus of this graduation project is to do exploratory research into sensory perception and how it can be modified. These will be compiled, sorted by the senses that they affect and finally details: fidelity (how true the level of detail that is sent is compared with reality), applicability (in terms of how universal or how subjective they are), usability, and scalability (availability, cost, context, and invasiveness).This compilation shall be backed up by existing research and projects that demonstrate the advantages and disadvantages of each sense.

From the collection of senses and projects using them; a 'map' or guide for designers will be created. This is done in order to help them select an appropriate approach to selecting and implementing additional senses to enhance their users' experience.

In order to validate this guide, the company (Mobgen) will assist in selecting a specific use cases to develop demonstrations for. These demonstrations will be developed using the 'map' which will be iterated upon and tested with other designers at Mobgen.

Finally, once the demonstrations are selected and developed they will be tested and undergo an iterative design process, with new realizations and modifications working their way upstream to the 'map'. The testing will also help validate the use of additional senses in an AR context.

start date   22 - 10 - 2018   9 - 5 - 2019   end date
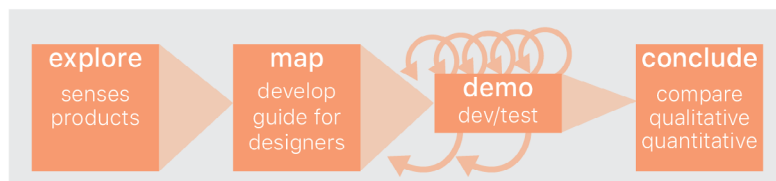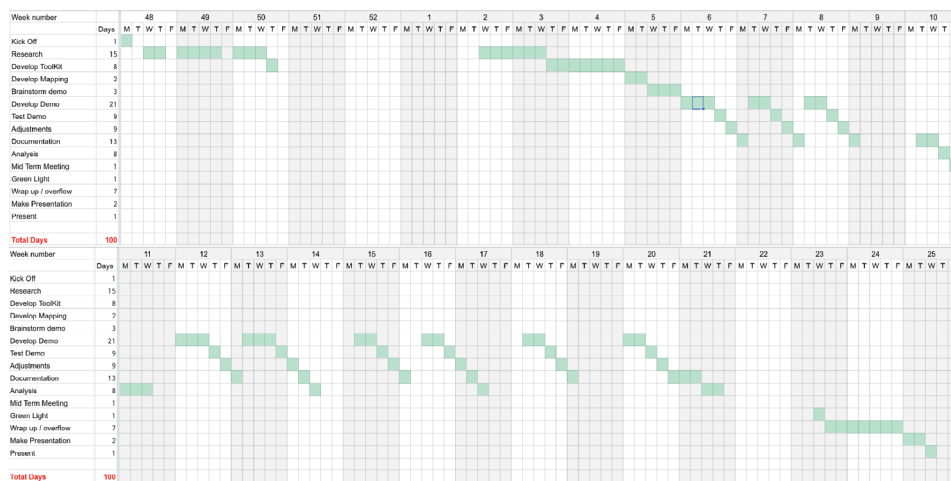

Fig 1

Fig 2

Please note that the total time for the project is 100 working days despite elapsing for more than 20 weeks.

The project is split into four phases named explore, map, demo, and conclude (evaluation) as Fig.1.

The first stage focuses on RQ1, which involves doing a literature review, as well as exploring commercial and 'homemade' devices used to interface with people beyond sight and sound. This information will be collated and used as a design space for the analysis phase.

After this exploration, a 'map' that helps designers select and implement appropriate senses into their designer will be proposed and iterated upon. (RQ2).

Utilizing this guide to develop some demonstrations, the project moves into the demo phase. This phase is an iterative design cycle focused on measuring and enhancing the user experience. Results from these cycles will be used to modify the 'map'. Additionally these demonstrations will then be tested, measure, and adjusted to validate how the 'map' helps designers as well as the effect of the added senses (RQ3).

Finally, the graduation project will focus on documentation, improving the ways in which the results of the testing can be communicated, and polishing the final demos.

Initials & Name   WIMT   Meijer   Student number 4221044

Title of Project   Augmented Reality Beyond Vision

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Personal Project Brief - IDE Master Graduation

TUDelft

MOTIVATION AND PERSONAL AMBITIONS
Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

The most important set of skills that I want to develop are: creating and implementing a more consistent and clear visual style throughout the project; focusing more on user experience and meaning creation rather than technical knowledge, and finally planning and executing multiple user tests to gather qualitative and quantitative data, either to feed in the design process, or to verify the product. These are all skills that are covered somewhat during the first year of the masters, however, the group nature of these projects and my background as a mechanical engineer means I rarely had a large stake in these areas.

As a note, some of the ideas, theories, and scope are derived from work I have done during ACD, when working with a VR company on creating additional meaning in VR environments using props.

Another personal ambition is to really test how I am working in a professional design setting and how well I thrive there. Hopefully, I will be able to impress the company enough so that they offer to keep my research going after I am done with my graduation project.

Therefore, to reach my personal ambitions, I planned to:
Think more creatively and conceptually;
Create working, documented, and demonstrable prototypes (not just of hardware but of the interactions and experience);
Document the process well enough to add this project to my portfolio.;
Set daily, weekly and monthly goals and keep them accountable with company and university supervisors.

FINAL COMMENTS
In case your project brief needs final comments, please add any information you think is relevant.

IDE TU Delft - E&SA Department /// Graduation project brief & study overview /// 2018-01 v30

Initials & Name ___WIMT___ Meijer _____   Student number _4221044_____

Title of Project ___Augmented Reality Beyond Vision_____

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901 Appendix 1: Senses Complete

Ranking

Each sense is rated on several characteristics that are crucial to make a selection. The characteristics are as follows:

- Fidelity (how much bandwidth and or realism is provided by the sense)

- Scalability (how difficult and expensive is it to produce)

- Usability (how easy is it for a designer to develop this sense)

- Speed (how quickly can the designer chance the input)

- Subjectivity (how much the input depends on the user)

Characteristics are estimated based on the example projects. Each sense has its own context in which it works well or not at all, thus, when selecting a sense, a designer must ensure that the context of their user fits the sense and in turn that the sense fits the context.

Sensations and human factors are significantly more dependent on the implementation, users, and context. Thus the ranking should only be taken as a general comparison between senses at the same level.
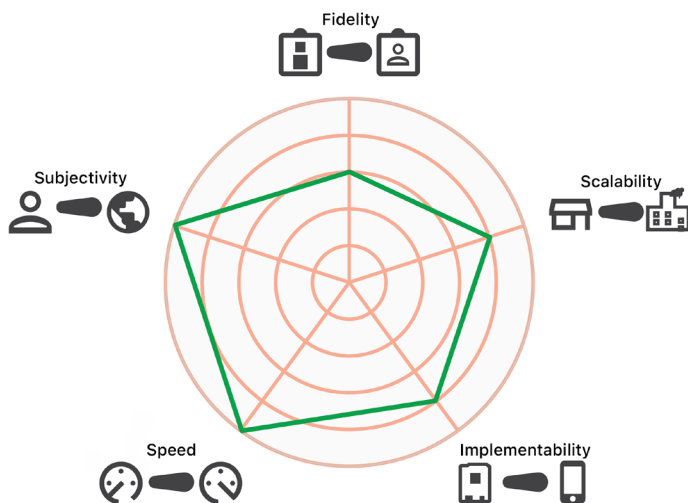
Senses

Each of the senses have a sensory organ or nerve ending that allows the brain to receive this information (Lawson, 2013). The senses covered in this section are compiled from both Lawson, 2012 and Proctor & Proctor, 2012. However, sight and sound are omitted due to being out of scope for this analysis (which aims to add additional sensory interactions) as well as pain, as it is not ethical to use. A number of other senses (such as hunger) are also omitted as they are not 'accessible' to designers.

The senses are as follows:
Vibration
Stretch
Pressure
EMS
Temperature Local
Temperature Global
Balance
Smell
Proprioception

Vibration

Description:

Vibrations are mechanical oscillations of force applied to the skin. This is usually done via vibration motors or linear actuators placed on the users' skin. This sense is often used in HCI projects and can be found as a simple, low fidelity solutions such as in cell phones. However, more detailed information can be shared using multiple motors and spatiotemporal mapping (Novich and Eagleman, 2015)

Examples of use:

Using space and time to encode vibrotactile information: toward an estimate of the skin's achievable throughput (S. Novich and D. Eagleman, 2015)
Feeling Speech on the Arm (J. Chen et al, 2018)
Tactile Feedback at the Finger Tips for Improved Direct Interaction in Immersive Environments (R. Scheibe et al, 2007)
The Development Of An In-hand-haptic-feedback Device Based On Magnetorheological Fluid (T. Eftling, 2012)

Notes:

Vibration is a low cost, low barrier method of sensory manipulation.
Vibration could be used to manipulate the texture felt by the user, however this would require extreme precision and timing.
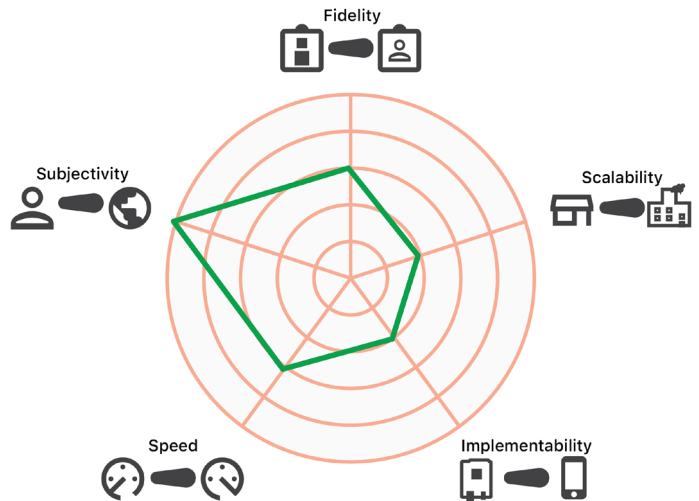
Stretch

Description:

Skin stretch is the sensation of the skin being pushed together or pulled apart, one of the three core parts of the somatic nervous system (Pruves, 2012). It has been shown to be able to provide low fidelity input (Quek et al. 2014), or even inputs as high as 5 degrees of freedom, but becomes limited when used in a situation where the user moves (Guinan et al, 2013).
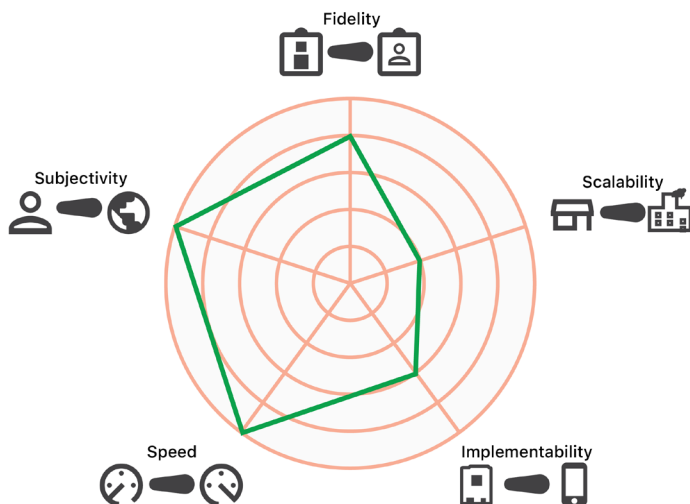
Examples of use:

Tactile Display Device Using Distributed Lateral Skin Stretch (V. Hayward and J. Cruz-Hernandez, 2000)
Sensory Substitution using 3-Degree-of-Freedom Tangential and Normal Skin Deformation Feedback (Z. Quek et al, 2014)
Back to Back Skin Stretch Feedback for Communicating Five Degree of Freedom Direction Cues (A. Guinan et al, 2013)

Notes:

While there are a number of research papers, ready made actuators are uncommon.
Caution must be used to ensure the stretching does not become painful.

Pressure

Description:

Pressure is a force exerted over an area of the skin, again part of the somatic system, with highly sensitive receptors on the fingers and lower sensitivity receptors on the rest of the skin (Pruves, 2012). Since the higher sensitivity receptors work together with vibration and stretch to from the perception of texture (Z. Quek et al, 2014), this section focuses on pressure as in squeezing the body.

Examples of use:

Affective Haptics: Current Research and Future Directions (A. Mohamad & O. Hussein, 2012)
Affective Haptics in Emotional Communication (D. Tsetserukou, A. Neviarouskaya, H. Prendinger, N. Kawakami and S. Tachi, 2009)

Notes:

It is possible to seriously injure the user with a pressure based system, caution must be taken especially when dealing with people in a weakened state.
Speed and usability greatly vary with the actuation method and set up of the system.
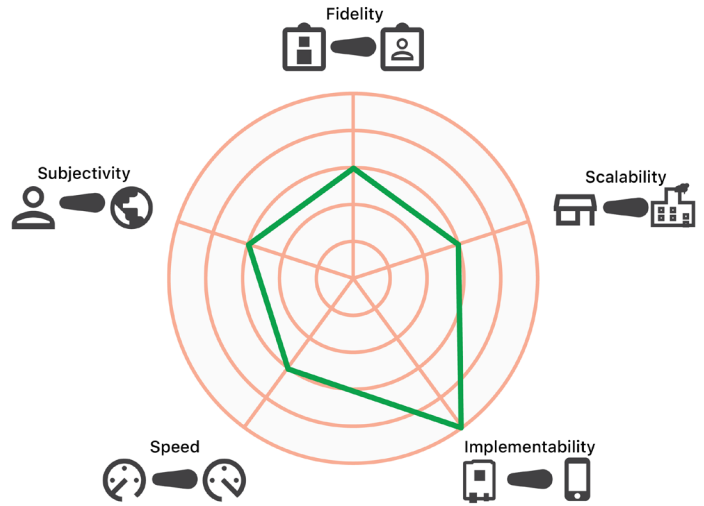
EMS

Description:

Electrical muscle stimulation is the process of using electrodes to trigger a user's muscles. On lower amperates, this merely causes a buzzing sensation, however, at higher voltages this causes muscular twitching (Lategan, 2011).
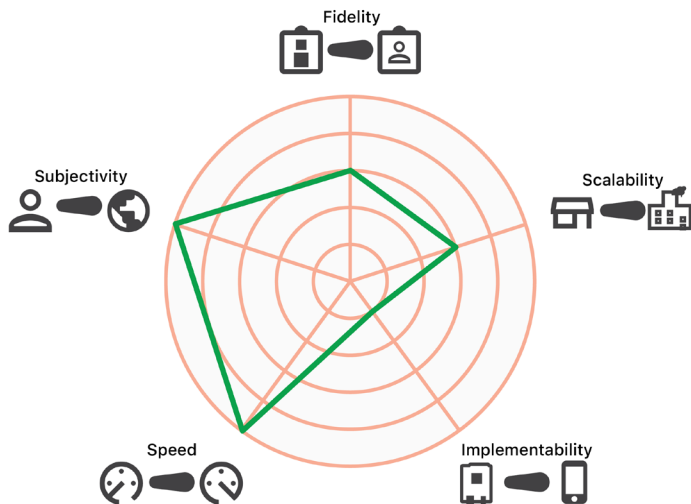
Examples of use:

plopes.org/ems/
Max Pfeiffer: Let Your Body Move

Notes:

EMS systems are often difficult to hack and can be damaged. It is extremely important to calibrate the settings of a system to each user as skin resistance changes with many factors. Please double check safety instructions for EMS systems. Additionally, if the voltage exceeds

a threshold, the muscle will trigger causing the user to move possibly against their will.

Temperature Local

Description:

Skin can sense it's temperature to a relative degree (above or below body temperature) and is able to do so for a small area (Lawson, 2013). This means a user will be able to tell when a heater is placed only on a certain part of their body.

Examples of use:

ThemroReal
ThermoReal 2
AmbioTherm

Notes:

Caution must be used when to ensure the temperature does not become too extreme which could cause discomfort or even harm the user.
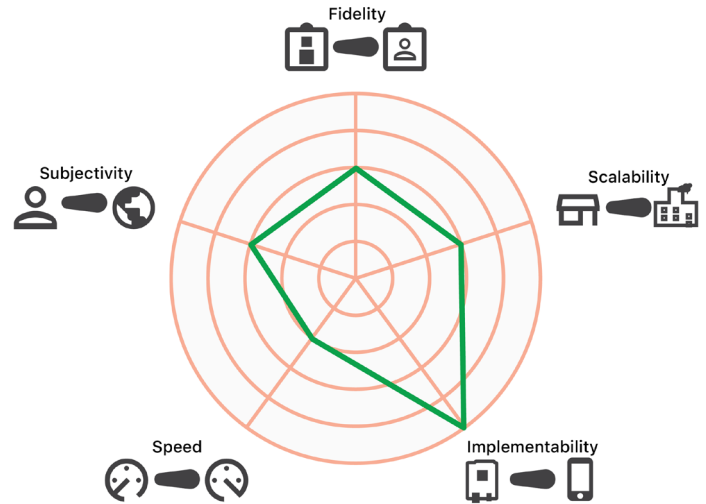It is easier to create higher temperatures than lower ones.

Temperature Global

Description:

Skin can sense it's temperature to a relative degree (above or below body temperature) and extrapolate this to the temperature of the users' environment. (Lawson, 2013) This is noted as global temperature.

Examples of use:

An Indoor Thermal Environment Design System For Renovation Using Augmented Reality T. Fukuda et al, 2018

Notes:

Caution must be used when to ensure the temperature does not become too extreme which could cause discomfort or even harm the user. It is easier to create higher temperatures than lower ones. It is difficult

to isolate temperature changes between different users.

Balance

Description:

In this case, balance refers only to the Vestibular System, responsible for angular orientation of the head (Bronstein & Pavlou, 2013).This allows the user to feel the sensation that their head is tilting to the left or right. The technical term for this process is Galvanic Vestibular Stimulation or GVS.

Examples of use:

Shaking the World (video)
Shaking the World (paper)

Notes:

The same cautions as EMS apply.
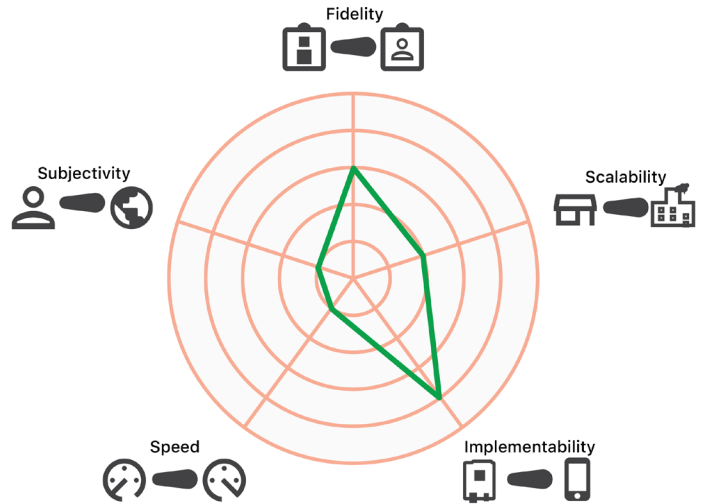It is very easy to cause discomfort and "errors" when modifying the GVS.

Smell

Description:

The human sense of smell is a complex mechanism that recognizes certain rich combinations of chemicals (Proctor & Proctor, 2012).
Unfortunately, no "base elements" of smell have been able to reproduce arbitrary smells. Thus, systems are limited to whatever smells the designer puts in them to begin with.
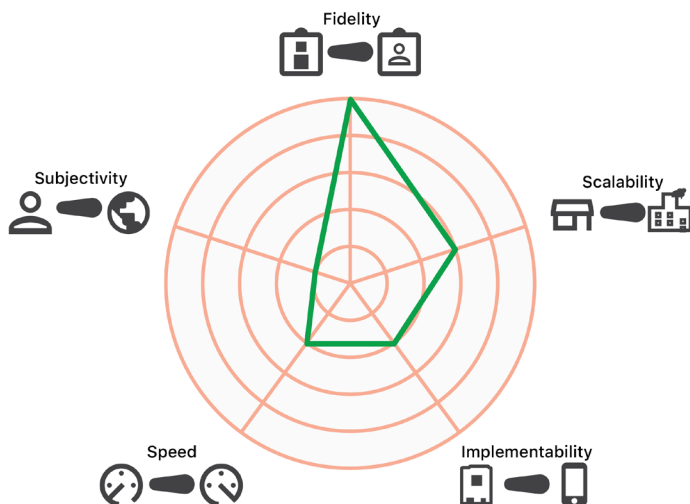
Examples of use:

An Unencumbering, Localized Olfactory Display Y. Yanagida et al, 2003
SensaBubble

Notes:

The reaction to certain smells is extremely subjective as it triggers specific memories. Thus extreme awareness of the users and their context must be applied when developing smell based systems.

Proprioception

Description:

Proprioception is the ability of the body to tell where it's limbs are using nerves in the muscles, tendons and joints (Lawson, 2013). This has proven immensely important in ensuring the user feels present in the virtual world, and concurrently the failure to anticipate proprioception causes the loss of presence (Vives & Slater, 2005).

Examples of use:

A Skin Stretch Tactor For Sensory Substitution Of Wrist Proprioception (O. Kayhan et al, 2018)
Electrotactile Stimulator for Artificial Proprioception (P. Nohama et al, 1995)
Artificial Proprioceptive Feedback for Myoelectric Control (T. Pistohl et al, 2015)

Notes:

902 Appendix 2: Sensations Complete
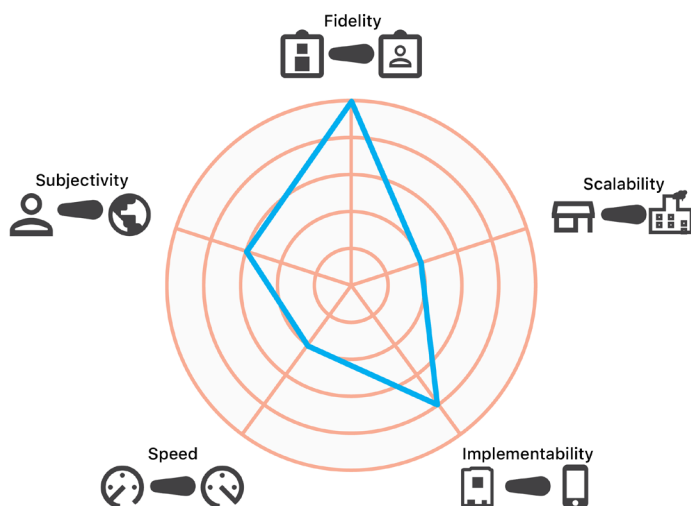
Sensations

So called "sensations" combine input from various sensory organs and enable deeper levels of perception. For example, the misnomered "sense of wetness" has no defined organ; it is a complex combination of the sense of touch and the sense of temperature (Filingeri et al, 2014).

This list of sensations is not complete, but merely lists sensations that have were deemed manipulatable or are shown to be usable in other projects.

The following sensations are covered in this section:
Wetness
Taste
Texture
Time
Direction
Spatial Perception
Spatial Cuing

Wetness

Description:

Wetness is the combination of the sense of temperature and the sense of touch on a localized part of skin (Filingeri et al, 2014), and is a 'learned sense' (Bregmann et al, 2012). Because of it's combined nature, the sense of wetness is susceptible to manipulation from both temperature and touch mechanisms as well as directly (i.e spraying the user with water).

Examples of use:

4DX Augmented Cinema (with water effects)

Notes:

Wetness is difficult to control finely, as sprays are difficult to control.
Wetness can cause discomfort when used for extended periods of time or combined with other inputs.
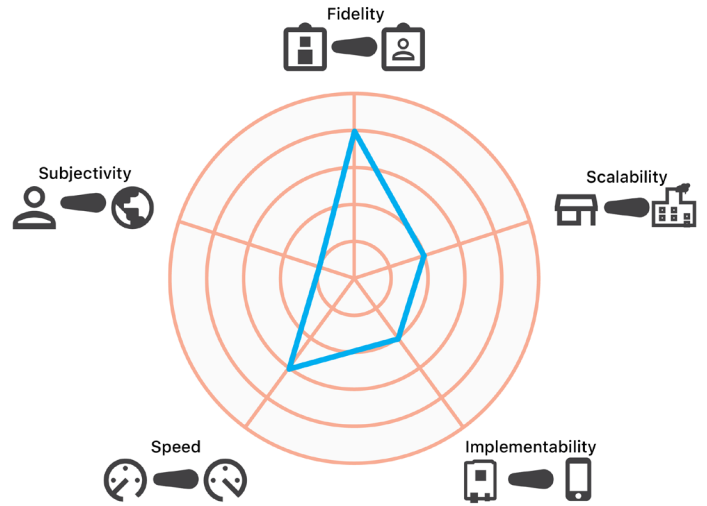
Taste

Description:

Much like the sense of smell, the human's taste is an attempt to perceive a rich combination of chemicals (Proctor & Proctor, 2012). However, taste is a much more complex perception, with a combination of sight, smell, and touch in the mouth influencing the perception of taste (Stevens, 1963).
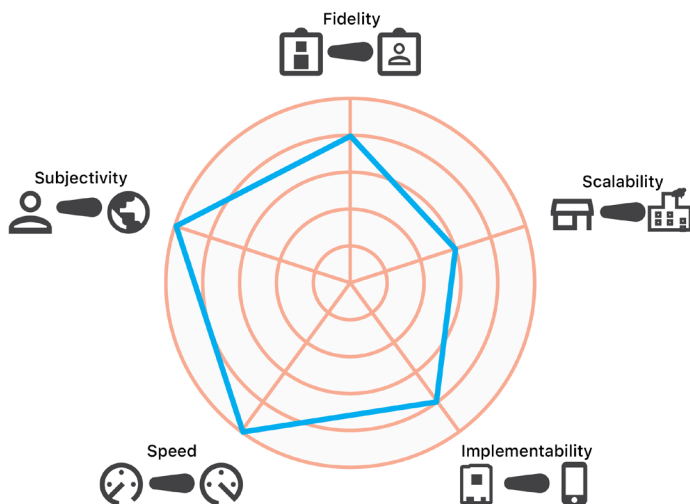
Examples of use:

Augmented Flavours: Modulation of Flavour Experiences Through Electric Taste Augmentation (N. Ranasinghe, D Tolley, T. Nguyen, L. Yan, B. Chew, & E. Do, 2012)
Augmented Gustation using Electricity (H Nakamura & H Miyashita, 2011)
Project Nourished

Notes:

Taste is a highly volatile sensation and difficult to reliably modify.

Texture

Description:

The human body uses static touch, skin stretch, and vibration when discerning the texture of a surface (Weber et al, 2013). This means that texture is challenging to replicate and can be the gap between the true and augmented world that a user senses.

Examples of use:

Sensory Substitution using 3-Degree-of-Freedom Tangential and Normal Skin Deformation Feedback (Z. Quek et al, 2014)
Weart.it

Notes:

Texture recording and playback has been accurately achieved by companies such as Weart.it, they also use visual cues (a video of someone touching the materials meant to be replicated) to help add to the illusion.

Time

Description:

Time is a massively complicated and misunderstood sensation. It includes judging duration (as seen in Wearden and McShane (1988)), rhythms (Unknown, 1936), remembering a timeline of events, and many other timing tasks.
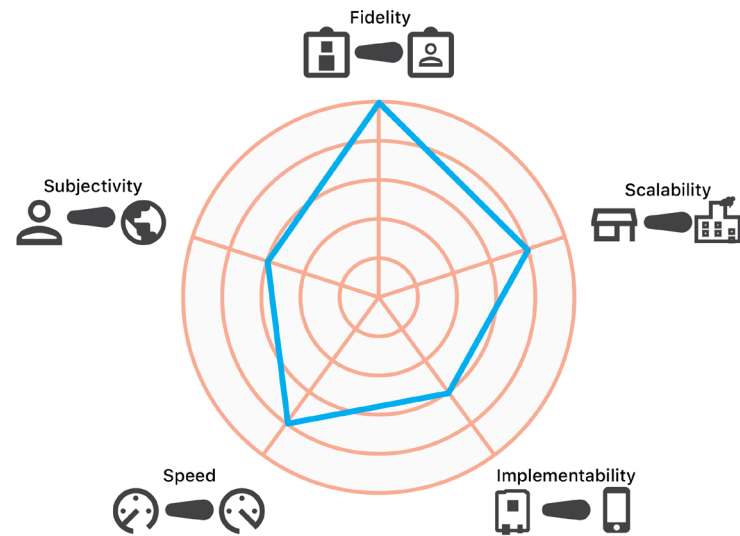
Examples of use:

Slowing down an internal clock: Implications for accounts of performance on four timing tasks (J. Wearden, 2008)
Effect Of Virtual Reality On Time Perception In Patients Receiving Chemotherapy (S. Schneider, C. Kisby, & E. Flint, 2011)
The Effect Of 3D Virtual Reality On Sequential Time Perception Among Deaf And Hard of hearing Children (S. Eden, 2010)

Fidelity

Scalability

Subjectivity

Implementability

Speed

Notes:

The manipulating sense of time can be a side effect of other manipulations.

Direction

Fidelity

Subjectivity

Scalability

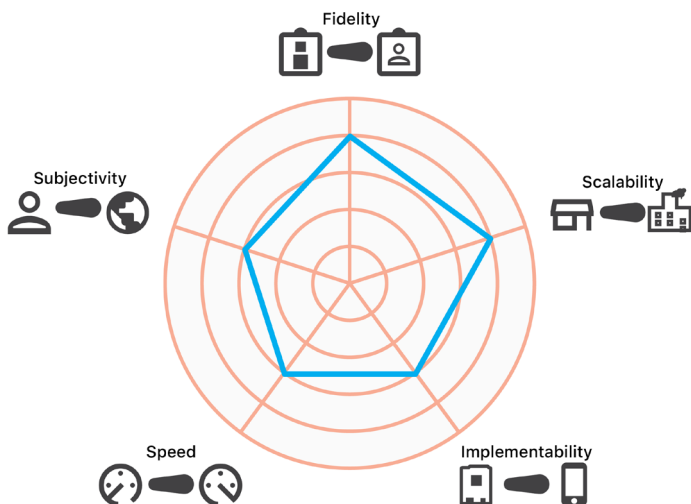**Speed**

Implementability

Description:

A person's sense of direction is really the building of a mental model of the space they are in and is mostly based on spatial perception and memory of where things are. As seen in Murakoshi and Kawai (2000), this means that the wayfinding and landmarks a person uses to form their sense of direction can be modified in a multisensory context; either through creating artificial landmarks (through sight and/or another sensory association).

Examples of use:

Navibelt
Measurement Methods of Spatial Ability Using a Virtual Reality System (K. Shimada et al, 2016)
Use Of Knowledge And Heuristics For Wayfinding In An Artificial Environment (S. Murakoshi, & M. Kawai, 2000)

Notes:

Users can have a wildly different sense of direction in terms of accuracy and cues that they pay attention to. Tailoring experiences to the users' unique sense of direction leads to powerful manipulations.
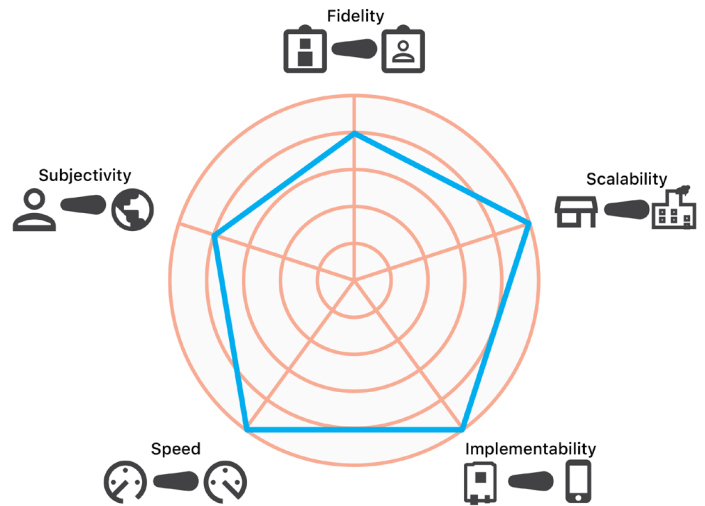
Spatial Perception

Description:

Spatial Perception is the mental model of how objects and structures are located in the space around the user. When perceiving objects in a space, humans make an distinction between manipulation level and whole body level judgements of location (Klatzky, 1998). Spatial Perception is made up of a combination of memories, heuristics, and many other judgements (Klatzky, 1998).
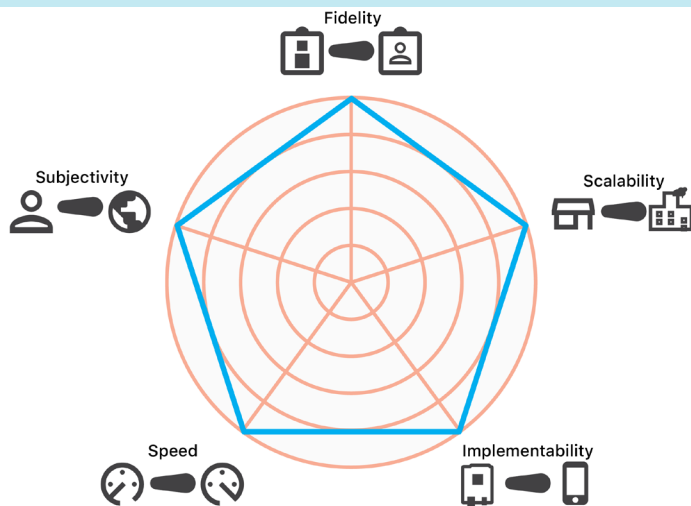
Examples of use:

Dynamic Redirection
Unlimited Corridor
Measurement Methods of Spatial Ability Using a Virtual Reality System (K. Shimada et al, 2016)

Fidelity

Subjectivity

Scalability

Speed

Implementability

Notes:

Spatial Cuing

Fidelity

Subjectivity

Scalability

Speed

Implementability

Description:

Spatial Cuing in this context is the idea that a combination of senses (classically sight and sound) can draw the attention of a user to a specific point in space more effectively than a singular sense (McDonald & Ward, 2000).

Examples of use:

Notes:

Spatial Cuing is a sensory analogy to Use Cues and is thus more of an understanding of a common affordance than a direct sense.

903 Appendix 3: Github Repositories and Structure

To be able to share the complex nature of the VR simulation and extra sensory wearable presented in this graduation there are two Github repositories that hold information. The first contains the XXR tool as two PDFs (one of the poster and another for the sense cards) as well as a copy of section 20 to explain the use of the tool. This is hosted at github.com/womei/XXRTool

The other repository holds all of the documentation for the Demo. This is hosted at github.com/womei/Demo42. Resources are split into three folders: Unity contains the full Unity project, MicroCode contains the code for the ESP8266 based microcontroller, and Hardware contains the electrical documentation for the wearable.

904 Appendix 4: Complete Test Data

participant number	Order Alarms	Rating 1	Rating 2	Rating 3	Order Alarms and Senses	Rating 1	Rating 2	Rating 3
1	3,2,1	5	9	6	1,2,3	8	10	7
2	1,2,3	8	4	7	2,1,3	6	8	10
3	1,2,3	2	4	3	2,1,3	5	8	10
4	1,2,3	5	7	6	2,1,3	8	9	7
5	3,2,1	4	6	5.5	1,3,2	6	8	5
6	2,1,3	8.5	8	5	1,2,3	9	9.5	7
7	3,1,2	6	8	2	1,3,2	7	7.5	6
8	1,3,2	4.5	8	6.5	1,2,3	8	6	6.5
9	2,1,3	5	8	1	2,1,3	6	8	5
10	3,2,1	5	4.5	3	2,1,3	6	8	5
11	2,3,1	1	7	5	2,1,3	4	6	10
12	2,3,1	8	6	5	2,1,3	5	7	6
13	1,3,2	10	8	2	3,1,2	8	9	8.5
14	2,1,3	7	8	6	1,2,3	8	10	7
15	1,2,3	2	3	1	2,1,3	7	8	3
16	1,3,2	7	6	4	2,3,1	8	9	5
17	3,1,2	6	5.5	4	3,1,2	5	7	7.5
18	1,2,3	4	3	2	3,1,2	7	5	6

I didn't want to leave this page blank, but I had to.

```cpp
#include <Arduino.h>

//Thanks so much to Stahl Now for the OSC code and examples
//https://github.com/stahlnow/OSCLib-for-ESP8266
#include <ESP8266WiFi.h>
#include <WiFiUdp.h>
#include <OSCMessage.h>
#include <OSCBundle.h>
#include <OSCData.h>

IPAddress local_IP(192, 168, 1, 100);
IPAddress gateway(192, 168, 4, 9);
IPAddress subnet(255, 255, 255, 0);
// A UDP instance to let us send and receive packets over UDP
WiFiUDP Udp;

const unsigned int localPort = 5005; // local port to listen for UDP packets (here's wh

OSCErrorCode error;

//Information for actuator wiring
const int PeltRed = D1;
const int PeltBlack = D2;
const int Pump = D8;

const int PeltMaxHot = 755;

bool LEDBlink = false;

void setup()
{
  // Set up all the pins
  // initite the motors and set to low:
  pinMode(PeltRed, OUTPUT);
  pinMode(PeltBlack, OUTPUT);
  pinMode(Pump, OUTPUT);
  pinMode(LED_BUILTIN, OUTPUT);

  digitalWrite(PeltRed, LOW);
  digitalWrite(PeltBlack, LOW);
  digitalWrite(Pump, LOW);
  digitalWrite(LED_BUILTIN, HIGH);
  // done setting up all of the pins

  //set up the WiFi network
  Serial.begin(115200);
  Serial.println();
  Serial.println();

  Serial.print("Setting soft-AP configuration ... ");
  Serial.println(WiFi.softAPConfig(local_IP, gateway, subnet) ? "Ready" : "Failed!");

  Serial.print("Setting soft-AP ... ");
  Serial.println(WiFi.softAP("Wo's thesis") ? "Ready" : "Failed!");
```