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DH2400 Physical Interaction Design and Realization

Sand Mirror – A personal reflection

Ideation process

We initially decided to gather because of our interest around inflatable devices linked to interactive clothing being inspired by the work of Clara Daguin for her "body electric" collection [1] or a paper by Jifei et al. [6] about inflatable and foldable structures. Or something around changing surfaces like the Wooden Mirror by Daniel Rozin [5] (which is not inflatable, but it was an inspiration) but applied to changing inflatable objects as balloons or structures like in Skouras et al. design of inflatable objects [7]. We also wanted to have something inspired by Swedish culture since we were in Sweden.

That's how we came up with the **wearable** "**HOPIMJ**": Heating Oversized Puff Inflatable Muscle Jacket (*Figure 1*), a shape changing **cloth** adapted to Swedish cold conditions and activated by body sensors. We've done some research around e-fashion and body. We discover the work of Behnaz Farahi, a creative designer and technologist working at the intersection of fashion, architecture and interaction design [2], she has done some work around interactive 3D printed fashion item inspired by the behaviour of the human body couple with gyroscopes and LEDs creating poetic movements. Lucy McRae, a sci-fi artist, film director and body architect [3] have for done a collaboration with the Swedish singer Robyn in her "Indestructible" music video, she is draped in a knitted, liquid textile made from water and air. Maiko Takeda is a Japanese fashion designer, she transforms tangible and mundane materials into surreal and ethereal experiences, there is a really detailed document about her work process and techniques on Google Art & Culture [4].
It brings us to have a reflection about the human body, how it is perceived by others during social interactions and how does body language codes apply to clothes. We took the example of cats who bristling their hair when they are afraid. We thought that the clothe could be activated by a different person than the one who is wearing it, and so, be a tool for **communication**.

Starting from that new point of view we start to focus about the interactions (*Figure 2*) and their meaning and discussed them with Ylva who gave us some good feedback and suggest us to start thinking how to handle technical issues according the different Inputs and Outputs.

We decided to push it further during one brainstorming where we thought about the meaning of what we were doing and ask ourselves what we want to display on the exhibition day, who will be there, what will they expect, what dazzle the eyes.
From that point we knew that we wanted to amuse, entertain the users and give them back their children gaze by focusing on games and having fun while interacting, so that's why we came up with the **theme or atmosphere** of "kids birthday party" and "fun vibes" (*Figure 3*) which was more or less an anticipation of the mood boards. We also wanted

something to surround, include and even immerse the participant to an experience and that's how we came to the **Inflatable Igloo/Tent** (*Figure 4*).

The "birthday party" theme was very "visual" and inspiring for us but we then tried to think about a deeper inspiration especially to have meaningful interactions. We start to gather ideas around social and environmental questions like sustainability, earth, overcrowding, ecological habits.
This is how came the project "**Humans•**" (*Figure 5*) where we merge an inflatable tent with the sumo suit to have a way to **visualize overcrowding and human's habits impacts to the earth** by sounds inside the tent and having image projections outside, on the tent surface Inspired by the Inner Garden [8], the Illuminating clay [9] or the Efecto mariposa [10]. Then by doing some research on "bubble-tent installations", we discovered Muda Colletivo's inflatable bubble [11] that can be described as spatial appropriation of the public space but also as a reflective and critical comment on how spatial design normally takes place within gentrification processes and real estate development. It symbolically imitates the process of real estate development and urban gentrification but is, at the same time, a micro-utopia suggesting an alternative, collectively constructed bubble.

So, the idea was in simple words, the more there are people inside the tent, more the sumo suits inflate and the tent "react" to show overcrowding population. Here we faced a technical issue because having so many sumo suits would have been too complex and expensive. That's why we restructured our project to the **IMPACT** project, an **inflatable bubble Earth that reacts to human actions** (*Figure 5a and 5c*). The aim is to have interaction metaphors embodied by toys and objects that represent your lifestyle habits and that you take inside the tent. Then depending where you will drop them, it will have an impact on the bubble earth materialized by sound (you hear related noise inside the tent), images (projections outside on the tent surface) and motion (ropes are attached to the tent ceiling and can pull it or release it). Also, a discussion with Ylva Fernaeus about Ishii and Ulmer Tangible bits paper [12] helped us to have a reflection around how physical, perception, socially oriented and electronically media components were fitting the project (*Figure 5b*).

A crazy thing is that we've found a giant 4*4 meters plastic tent behind a trash in the street that was incredibly fitting the project! But we didn't used it because we decided to shift our perspectives to the Sand mirror project.
Even if this **IMPACT** project isn't link to our Sand mirror project, I wanted to mention it because it took us important time and involvement efforts before dropping it. I also think it's important to mention some important paths that we went through and choose to abandon because it is part of the whole process.

The sand mirror

We finally decided to change our ideas to get a fresh start with a new one: a **sand mirror**. It was inspired by a youtube video named "Round Sand Picture Time Lapse" [13]

The idea is a **remotely controlled interactive artwork** that could act as a social hub, to have fidgety and (attention-wise) peripheral characteristics. A soft controller controls actuation in the artwork (*Figure 7*). It is thought as an **ambient relaxation device**. As something made to catch attention and relax the user, we initially wanted to have something calm around nature, with geometrical patterns like fractals and honeycombs

(*Figure 6*). We thought about something slow and delicate like the project "Slow Dance" [14]. It was important to **engage the body of the user** by making him touch and bend the soft controller because it **also engage his mind and thoughts**.

In his book "Descartes' Error: Emotion, Reason, and the Human Brain" [15], Antonio Damasio makes a critic of Descartes dualism and goes through neuroscience cases study to show that **thoughts and emotions are needed in rational thinking and social behaviour**.

Arthur Schopenhauer's doctrine parallels **Buddhism philosophy and meditation** in his affirmation of will to live, compassion towards existence, asceticism and renunciation as a response to suffering and desire and that **aesthetic experiences are a way to escape the misery of the world** [16]. So, applied to our sand mirror, a tangible object with visual aesthetics could help a person escaping from negative thoughts, boredom or tiredness. Another eastern philosopher that we can relate to Buddhism philosophy is David Hume with his doctrine of the "non-self" ("Anātman" for the buddhists) that there is no unchanging permanent self [17]. Here, having a mirror that doesn't represent your reflection but your actions, also that link your body to the physical world through touch and through nature embodied in the device (sand, water, wood) could be a way to keep your feet on the ground, link and connect with your environment. In fact, in a lot of meditation techniques it is advised to picture our physical connection between our body and the world (a hand on a table, an arm on a chair's arm, feet on the carpet, giving attention to surrounding noises while eyes closed, …). The theory that the mind is included in a body, which is included in an environment and that they all interact and influence each other, is called Embodied Cognition (Varela, 1991 "The Embodied Mind"). That open perspectives about being the actor of your life and that it doesn't matter how the sand and iron moves into the structure but what matter is starting to act on it.

"*Al andar se hace camino*" (by walking you create the path)
— Antonio Machado's (poem "Caminante, no hay camino")

Technical process, issues and solutions

The labs sessions we had in the beginning permit us to explore laser cutting which was helpful for the acrylic frame and the wooden cogwheels. The soldering helped us regarding the electronics used with the Arduino to create the motion.

The controller // We first focused on the soft controller by testing how sensors were reacting inside silicon. What **materials** could be used to induce relaxation, how to make it soft, graspable and convenient. The talk by Vasiliki Tsaknaki about "Materials and form-giving in interaction design" helped us to consider the different options of silicon, play-doh, real baking dough, fur, balloons filled with sand, slime or memory form foam. We decided to go for memory foam wrapped in fur (*Figure 11*).

The disc frame // We first laser cut several prototypes with plastic acrylic of different shapes (square, round "blob", circle) to explore what would be an interesting shape. We collect interesting materials to put inside the frame, like plastic straws, filtered sand, metal small objects, wood and iron powder. The final disc frame size is 30 cm diameter and it is made of acrylic plastic. We had a lot of issues with gluing the two pieces of acrylic together and make it waterproof at the same time. We tried with silicon, with glue, with the two combined, with Epoxy, with Epoxy glue and superglue and finally with Acrifix glue.

We fixed it on a rod, with ball bearings keeping it in place and enabling spinning. A motor is attached to the end, spinning with a cogwheel construction. Indeed, we organized it by layer with the visible components in frond and the mechanics behind (*Figure 8*)

The cogwheels // Regarding the magnet movements on the back, we used cogwheels to create a motion basing our design on some creation that the website http://www.papermech.net/ suggests (*Figure 9*). Coming with a structure model that was strong enough to support the weight of the whole system was challenging, we've done a lot of research about cogwheels, bearings, chains, mechanical ways to create motion regarding our many constraints (form of the objects, attached to something, weight, strength of the motors, etc).

The code // The code of the Sandmirror is supported by Arduino. The board set up is a combination of different components (*Figure 10*). The code is processing the actions made on the components (flex sensors, accelerometer and gyroscope) contained in the controller and send the info by WIFI to the motors to activate the cogwheels and the magnets that activates the iron powder inside the frame (the same network between the WIFI module and the laptop connected to the wheels and motors). We are using MPU-6050 and flex sensors to get information on how much the user is moving the controller. Firstly, we discover the movement and wake up the program. Later, each 0.1s we check how much the values from the gyroscope and the accelerometer are changing, and based on that increase or decrease general energy value of the controller.

Conclusions

This was a great experience of designing and realizing a concrete project, it showed me that it is possible to start and develop an idea but ending up with something totally different at the end so much the perspectives have changed.

It was also a benefic experience to have daily access to the fabrication lab because it leaves us the time to familiarize with it and experiment a lot of different techniques, encounter issues and go over them.

One thing I wish we would have put more focus on, is to dig deeper about the meaning of the materials and the interactions like we've dig it for our first bubble earth idea. Have a design path structured around why is the human here, what is he doing, how does he interact. I went to the Moderna Museet and they were having a talk by Eero Lundén about his work for Nordic Pavillon at the Biennale Architettura 2018 in Venice [18]. He went into the details of his design process, his thoughts, choices, mistakes, etc. I noticed that it was fundamental to have a solid base and pay attention to details during the whole process to end with something strong at the end. Also, it made me thought about the famous modernist phrase "**Form follows function**" meaning that the shape of an object should primarily relate to its intended function or purpose. In HCI we should always keep in mind why and how is the human here and that "**function follows human needs, form follows human behavior**".

References

[1] Clara Daguin http://www.claradaguin.com/

[2] Behnaz Farahi http://behnazfarahi.com/

[3] Lucy McRae https://www.lucymcrae.net/

[4] Maiko Takeda https://artsandculture.google.com/exhibit/LAJS9QemFaibJQ

[5] **Wooden Mirror** by Daniel Rozin (https://youtu.be/BZysu9QcceM)

[6] Ou, J., Skouras, M., Vlavianos, N., Heibeck, F., Cheng, C. Y., Peters, J., & Ishii, H. (2016, October). **aeroMorph-heat-sealing inflatable shape-change materials for interaction design**. In *Proceedings of the 29th Annual Symposium on User Interface Software and Technology* (pp. 121-132). ACM.

[7] Skouras, M., Thomaszewski, B., Kaufmann, P., Garg, A., Bickel, B., Grinspun, E., & Gross, M. (2014). **Designing inflatable structures**. *ACM Transactions on Graphics (TOG)*, *33*(4), 63.

[8] Joan Sol Roo, Renaud Gervais, Jérémy Frey, Martin Hachet. **Inner Garden: Connecting Inner States to a Mixed Reality Sandbox for Mindfulness**. *CHI '17 - International Conference of Human-Computer Interaction*, May 2017, Denver, United States. ACM, CHI '17, 2017, CHI '17 https://hal.archives-ouvertes.fr/hal-01455174

[9] Piper, B., Ratti, C., and Ishii, H. **Illuminating clay: a 3-d tangible interface for landscape analysis**. *In Proceedings of the SIGCHI conference on Human factors in computing systems*, ACM (2002), 355–362 https://youtu.be/tL449hP_H6A

[10] Gonzalez, P. **Efecto mariposa**. 2011
http://patriciogonzalezvivo.com/2011/efectomariposa/

[11] **Muda Colletivo's inflatable bubble :**
HALDRUP, Michael et. al., **Remix Utopia: Eleven Propositions in Design and Social Fantasy**. Nordes 2015: Design Ecologies. Nordic Design Research, n.6, 2015.
https://rucforsk.ruc.dk/ws/files/55641672/386_727_1_PB_2.pdf
http://coletivomuda.com.br/

[12] Ishii, H., and Ullmer, B. **Tangible bits: towards seamless interfaces between people, bits and atoms**. *In Proceedings of the ACM SIGCHI Conference on Human factors in computing systems, ACM* (1997), 234–241.

[13] Round Sand Picture Time Lapse https://youtu.be/c1NvRi_OgzI

[14] Slow Dance https://www.kickstarter.com/projects/xercyn/slow-dance-a-frame-that-slows-down-time

[15] Antonio Damasio. 1994. "Descartes' Error: Emotion, Reason, and the Human Brain"

[16] Arthur Schopenhauer. 1819. "The World as Will and Representation"

[17] David Hume. 1738. "A treatise of Human Nature"

[18] Eero Lundén, **Another Generosity** for Nordic Pavillon at the Biennale Architettura 2018 in Venice https://youtu.be/_GRgoY-cbAY

Figures

Left: [Figure 1: HOPIMJ]
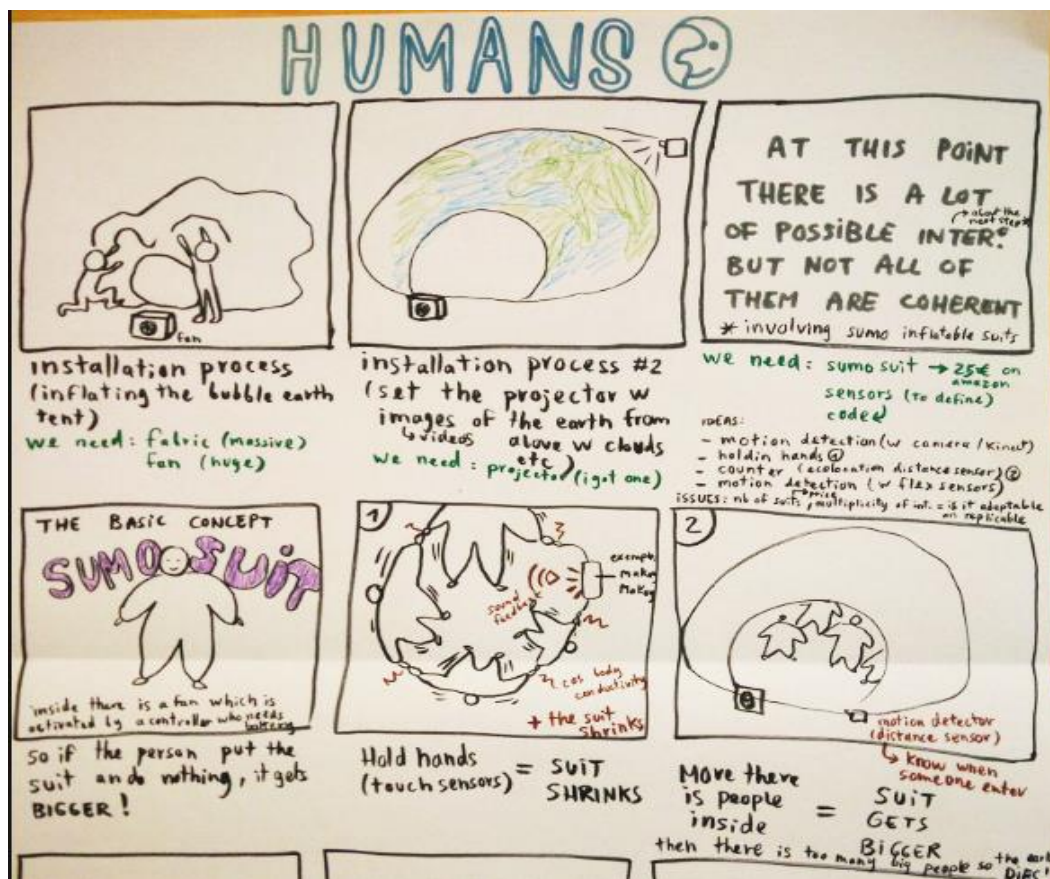
Right: [Figure 2: Research about clothing input/output]
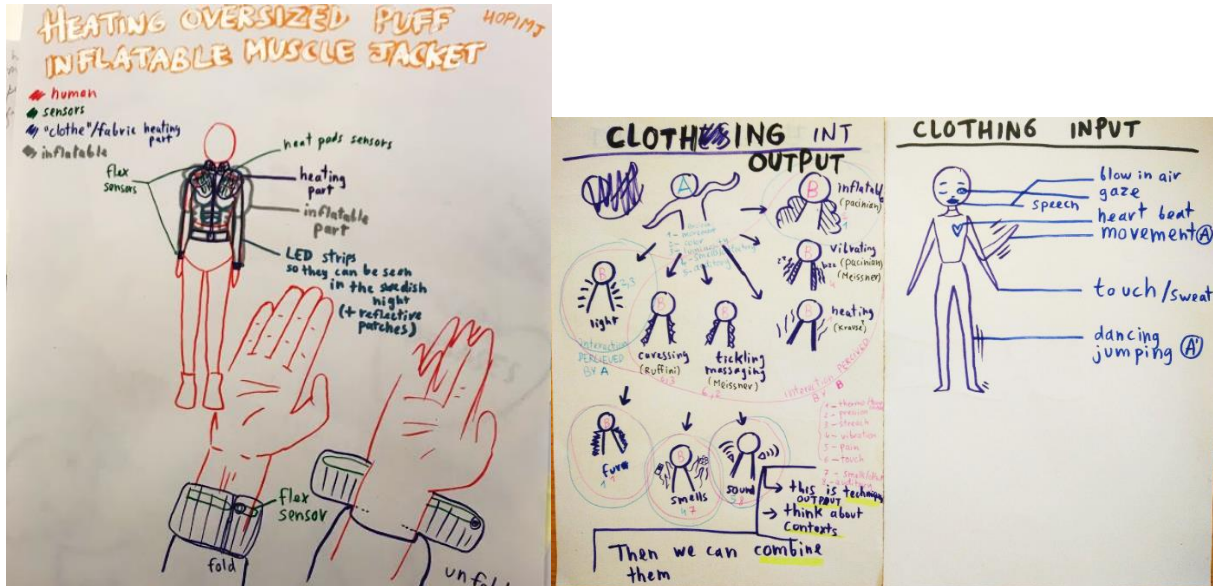
[Figure 3: Brainstorming "birthday party"]

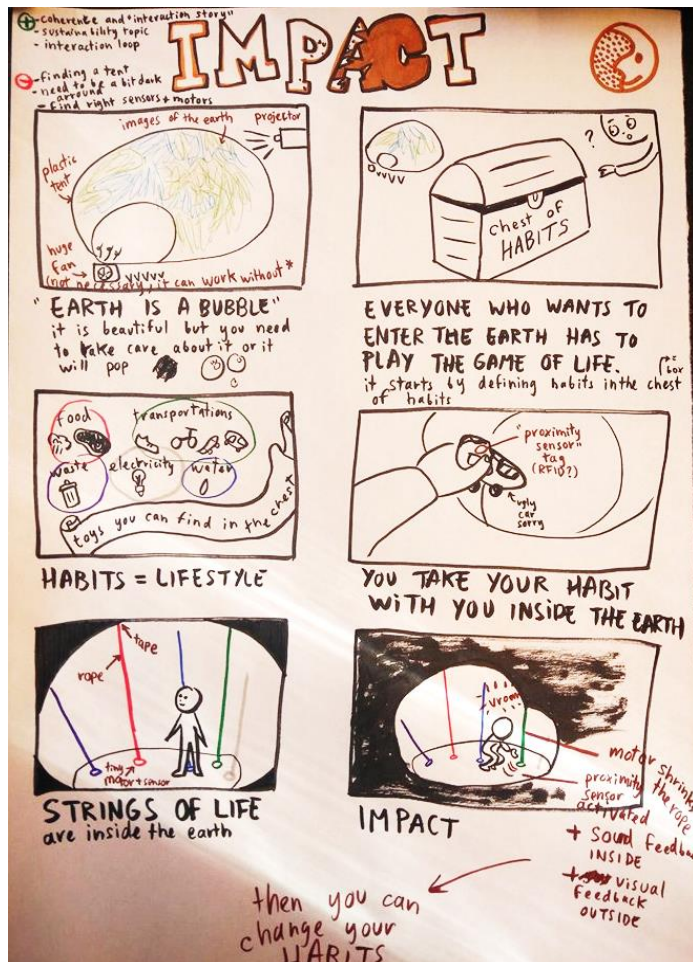[Figure 4: Shifting from inflatable clothes to inflatable tent]

[Figure 5: **Humans**•project]

Left: [Figure 5a: Humans• became **IMPACT**]

Right: [Figure 5b: **IMPACT** components reflection]

Bubble that you enter, you can touch the surface of it + objects (toys) that you grab and move + physically pull the ropes, touch them

Physical

Socially oriented
Open discussion about sustainability in a soft way (non-aggressive/doesn't feel blamed) + play with toys + chill in the bubble tent as an architecture invitation

Perception
Sound inside the tent (noise related to the toy) and image outside (earth pics changing regarding your actions) + you see the décor/environment (fan, motors, plastic, ropes) = engaging/magical

Electronically media
Objects are activated by being put next to the base of the rope (RFID/proximity sensors) + motors to pull the ropes

[Figure 5c: **IMPACT** moodboard]
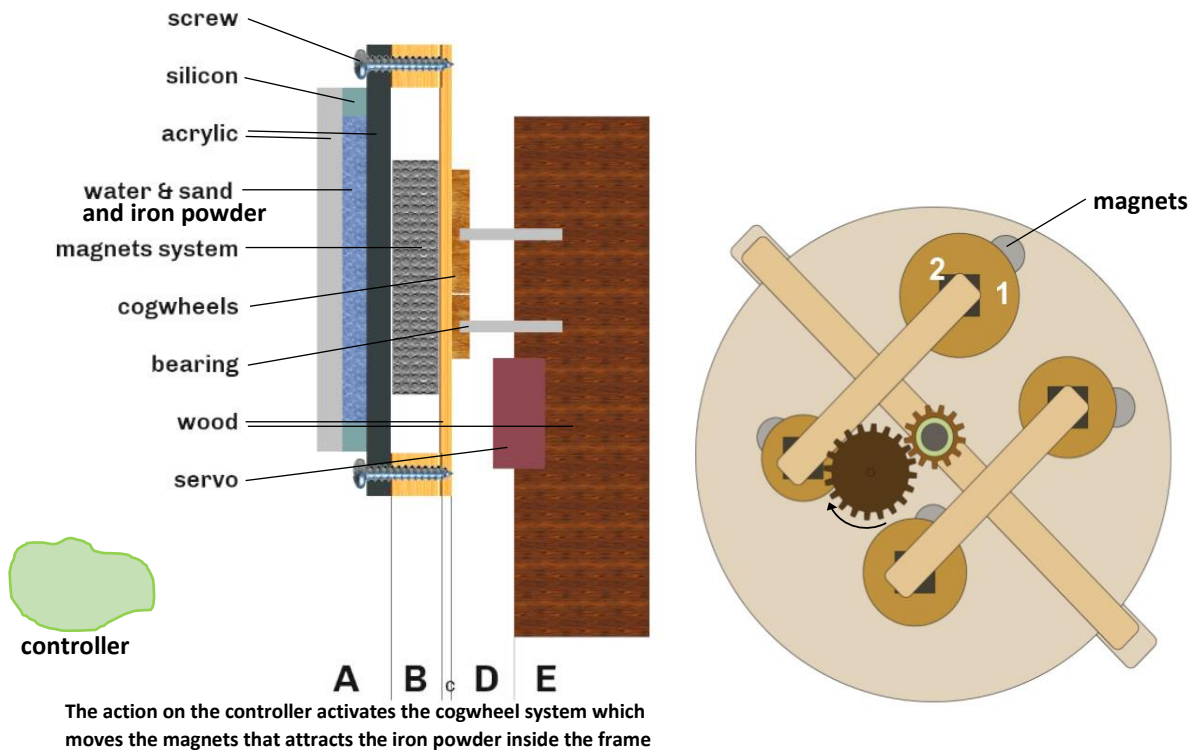
[Figure 6: Sandmirror moodboard]

[Figure 7: Sandmirror storyboard]

Left: [Figure 8: Sandmirror frame structure organisation]

Right: [Figure 9: cogwheel and magnet system (part B, C and D)]

The action on the controller activates the cogwheel system which moves the magnets that attracts the iron powder inside the frame

Left: [Figure 10: Controller board structure]

Right: [Figure 11: materials for the controller. 1-plush material, like memory foam 2-sand or flour 3- plastic wrapping, eg. balloon 4- soft material to cover like fur]