Designing Gaming Wearables: From Participatory Design to Concept Creation

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Abstract
In this pictorial, we depict our design process on gaming wearables starting from participatory design workshops to concept creation. Wearables possess strong qualities for gaming such as performativity, sociality and interactivity. However, it is an emergent field and there is a dearth of design knowledge especially when it comes to designing wearables for mainstream gaming platforms such as game consoles. Our aim is to explore this field elaborately with a research through design approach and also clearly exemplify how our design process progressed through different phases. Our results, apart from helping wearables designers to understand critical features for mainstream gaming, will also demonstrate the techniques and methods for extracting knowledge from PD workshops and incorporating it in a conceptual design phase.

Authors Keywords
Wearables, Participatory Design, Design Research, Games, Game Research, Costumes, Cosplay

CSS Concepts
• Human-centered computing~User Interface design; Interface Design Prototyping; User Centered Design

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Figure 1: Head-On Concept in the making during the Fusion Workshop

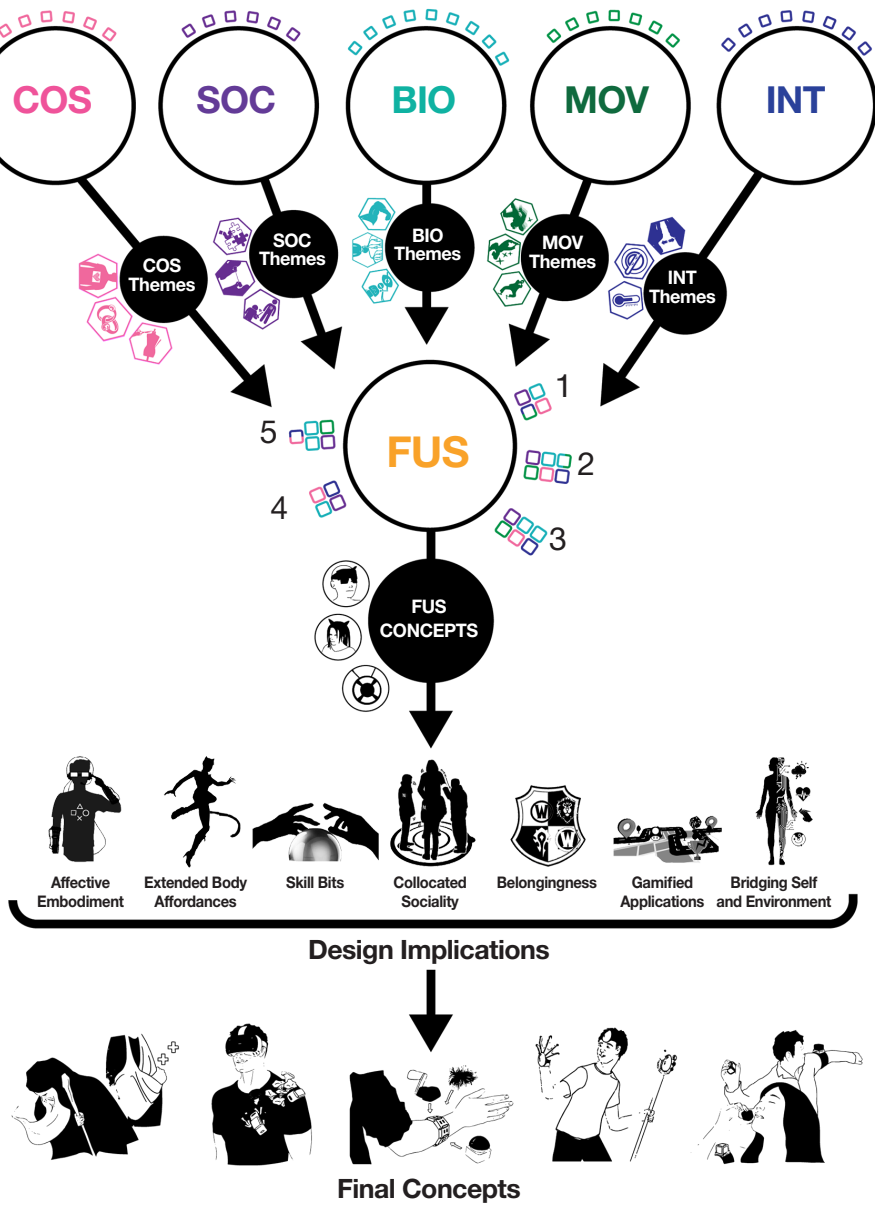


Figure 2: Overview showing our design process starting from workshops to final concepts

INTRODUCTION

Recent developments in the sensorial part of gaming gave birth to an emergent field called gaming wearables. Although, it started to expand recently, there are a few popular trials to commercialize wearables for playing games. Power Glove [8] which was released to be integrated to Nintendo Entertainment System in 1989 is one of the first and most popular examples of gaming wearables. The movement tracking technology through ultrasound was not very accurate at that time and thereby, this product was not a huge success. BCON is a more recent example and also focuses on translating movement into commands with a foot-based and programmable approach [16]. Actually, gaming wearables attracted considerable interest from players before BCON is released. For example, Fallout 4 Pip-Boy Edition was reported as the fastest selling collector edition ever [21], while Pokemon Go+ was sold out in an unexpected pace according to Nintendo [28]. Still, commercial wearables are not many in terms of variety and examples are almost limited to ones mentioned here. These examples also do not provide rich design knowledge, since their connection to game mechanics are limited and the ones who provide better connection to games such as Nintendo Labo Robot Kit lack versatility [18]. So, how can we design wearables that can add to the player experience in mainstream gaming systems such as consoles, extended reality or mobile platforms? What might be the key features of gaming wearables? How can they provide novel experiences?

To answer these questions, we organized a series of six workshops focusing on the different aspects of gaming wearables, with 33 participants. Consecutively, these workshops focused on *costumes as game controllers (COS), social interaction through game wearables (SOC), bidoadaptivity in games (BIO), movement of body in games (MOV)* and *interaction modalities in gaming wearables (INT)*. In the sixth, the *Fusion Workshop (FUS),* we hosted the participants of the first five workshops and created groups that include participants ideally from each workshop and from different disciplines. The reason behind choosing these specific aspects were based on the previous research on playful wearables. Buruk, Isbister & Tanenbaum [6] created a comprehensive design framework for playful wearables emphasizing 1) performativity, 2) sociality and 3) interactivity as the strong parts of playful wearables by drawing on four influential playful wearable projects they developed. Other than that, (4) transferring body signals [29] and (5) movement tracking especially in mobile or low-light settings were indicated as strong parts of wearables [2,33]. Therefore, the topic of our workshops focused on those specific aspects. After the workshops, we extracted design implications and by considering these implications we developed five wearable concepts which will be tested through low-fidelity prototypes in the next step. We visualized all design knowledge created through the process and used these visualizations as a narrative tool and also as part of our design process. Therefore, the contribution of this wearable is two-fold:

1) Five mainstream gaming wearable concepts drawing on the stakeholder-oriented design knowledge in the forms of 15 themes, 7 design implications and 3 intermediary concepts.

2) A design technique that benefits from gameful visualizations demonstrating the transfer of design knowledge between phases.

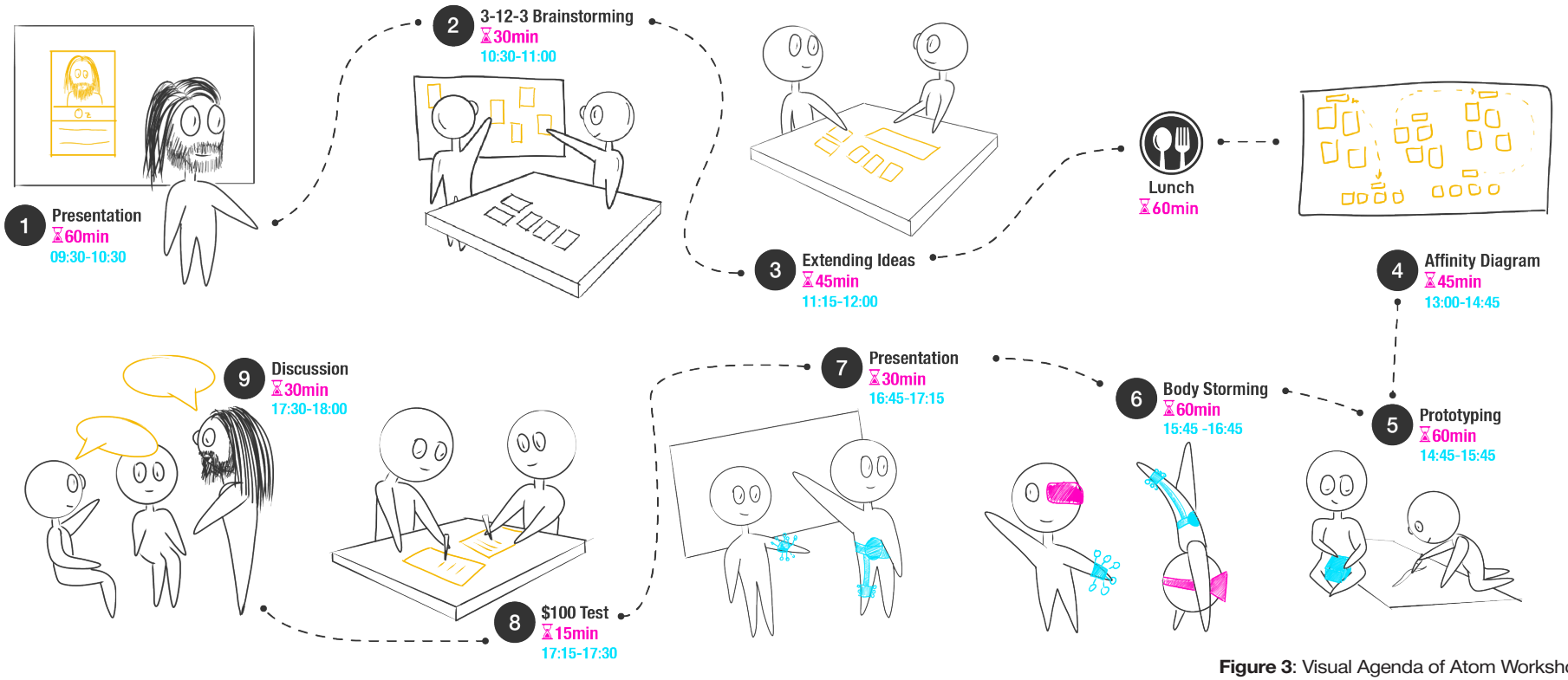


Figure 3: Visual Agenda of Atom Workshops

PARTICIPATORY DESIGN WORKSHOPS

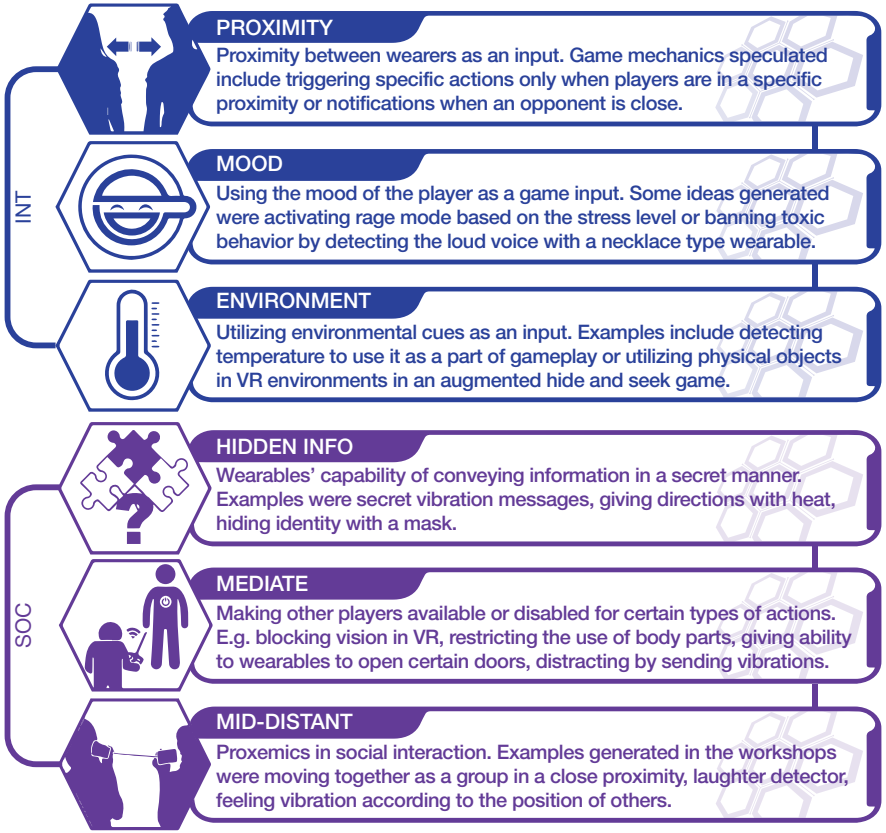
In our study, we thoroughly reported the design knowledge and artifacts created through our participatory design (PD) workshops [1,22] that reflects the opinions of different stakeholders. PD involves different stakeholders in the design process and the background of stakeholders depends on context and need [3]. We involved stakeholders continuously [3] throughout 6 (5+1) workshops with a fragmented workshop structure that we call "Atom Workshops (Figure 2)" to make sure that a rich design knowledge was generated that can cover all these distinct facets. Atom workshops were similar to Dialogue-Labs [24] method with an extended and modified structure for embodied interaction, by including exercises such as body storming [26], paper prototyping [31], 3-12-3 Brainstorming [17], $100 test [17] and Affinity Diagrams [23]. In multi-faceted topics, it is important to sensitize participants [35] and previous studies had employed different methods such as role-play [35] or embodied performances [27]. In our case, we chose to sensitize our participants with full-day Atom Workshops focusing on strong points of wearables. Sensitized participants came together for a more "doing" oriented Fusion Workshop where they can use the knowledge from Atom Workshops to create unified concepts which were presented through video sketches [37]. Figure 2 and 3 depicts the whole flow of the study and the workshops in detail.

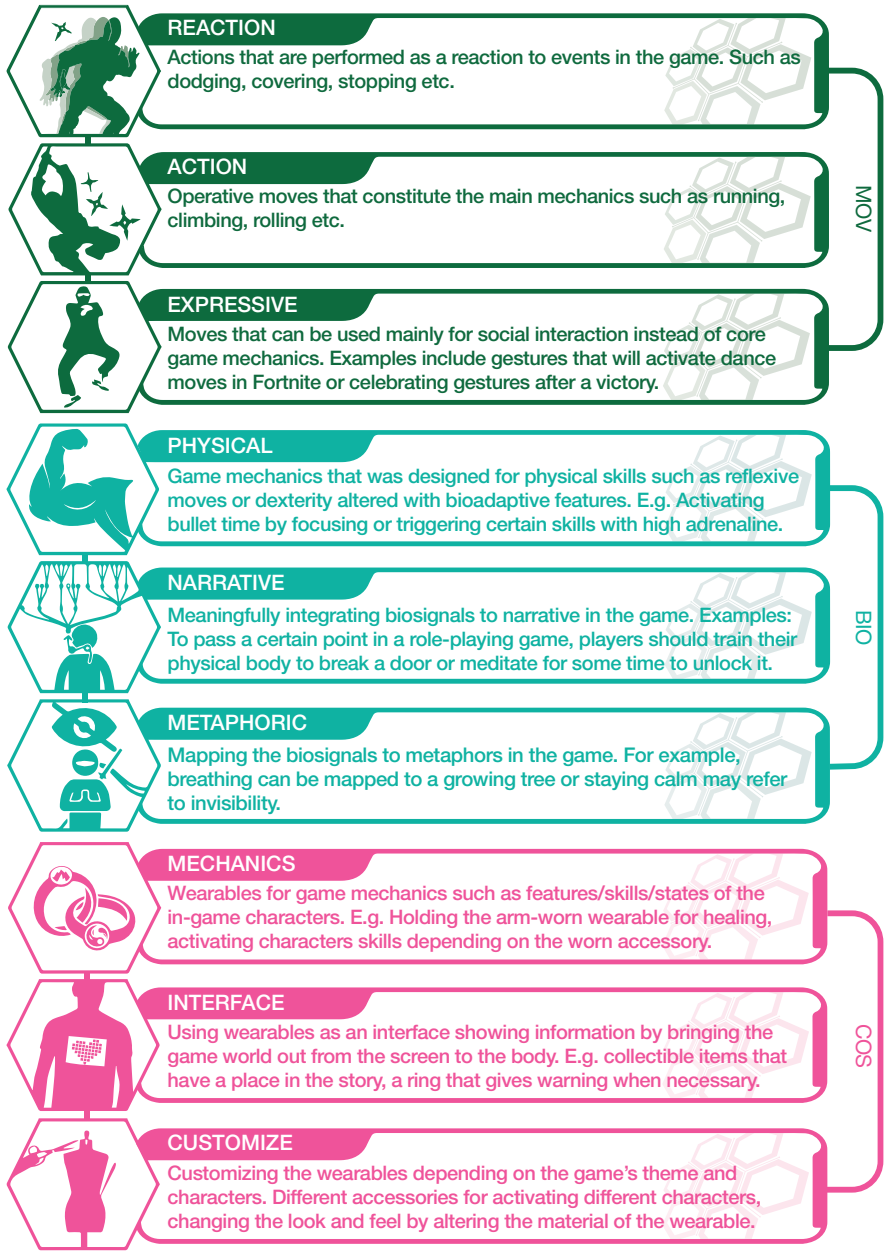
Workshops were part of the "Design Thinking for Wearables, Body and Games" course in Tampere University. We hosted 33 participants who are 22 graduate students, 5 undergraduate students and 6 non-student experts from different fields. Graduate students were from HCI (6), game studies (3), IT (4), electric (4) and biomedical (1) engineering. 8 of these graduate students had extensive professional experiences such as UX lead position in Nokia, consultation in game companies, indie game development experience or artist position in game development projects. Expert participants also had different expertise on topics such as game design, research, psychophysiology and cosplay.

KEY THEMES EXTRACTED FROM THE WORKSHOPS

In Atom Workshops, participants voted for their favorite themes, a narrowing down method suggested by Gray et al. [17]. In this section, we illustrated the most voted three themes of each workshop. These themes immensely guided us while forming the design implications which are the primary drivers of the final concepts presented in the end of this pictorial. We created icons for each theme for clearly connecting them to the intermediary concepts and design implications. Design problems that was addressed in each Atom Workshop were as follows:

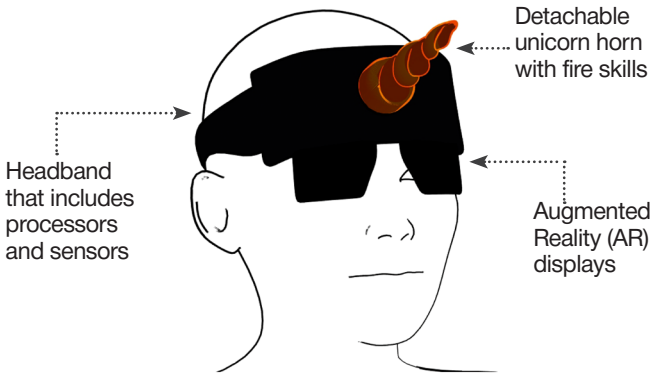
- INT How can we interact with wearables while playing games?
- SOC How can they support distant and collocated social interaction in games?
- MOV How can body movements be incorporated in main stream game systems?
- BIO How can our body signals become a part of games?
- COS How can wearables behave as costumes in current gaming systems?

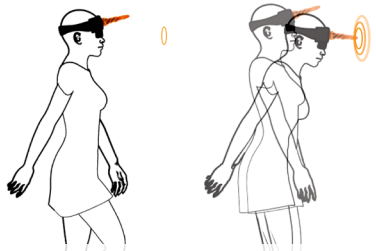




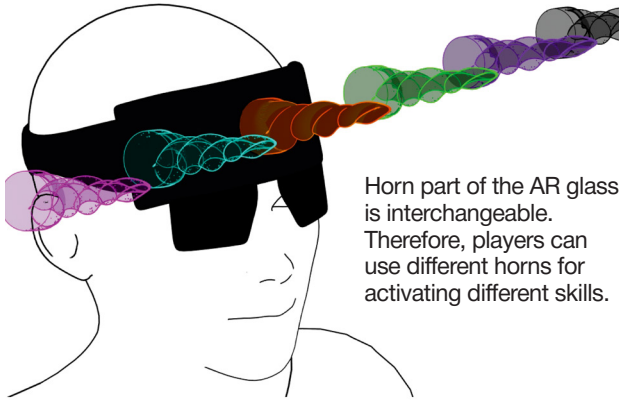
CONCEPTS OF FUSION WORKSHOP (FUS)

In **FUS**, participants created intermediary gaming wearable concepts by unifying the knowledge created in Atom Workshops. In this section, we present an Annotated Portfolio [12] by mapping the key themes of Atom Workshops to these intermediary concepts. Colors represent themes from different workshops while the icons represent the specific themes. Thus, while more colors mean that the concept draws on various strong aspects of wearables, more icons means deeper exploration of specific topics.



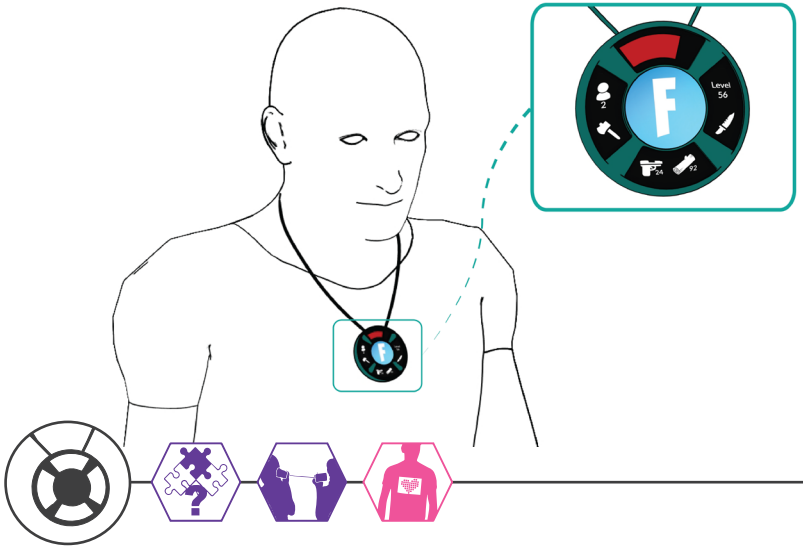


Unicorn Experience is used for detecting certain targets scattered around the physical environment and destroying them by hitting with the unicorn horn.

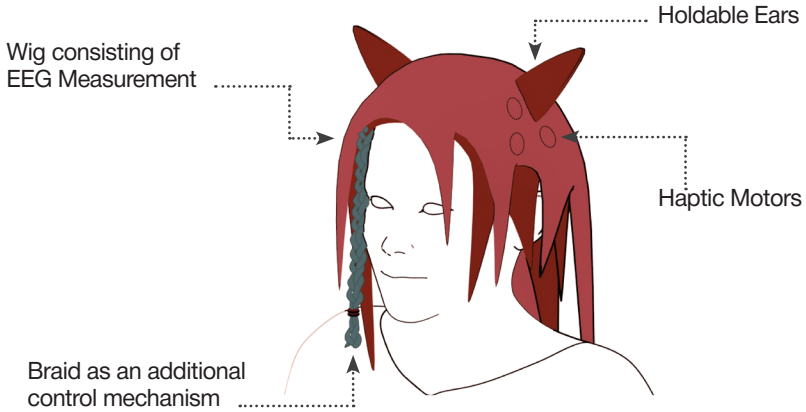


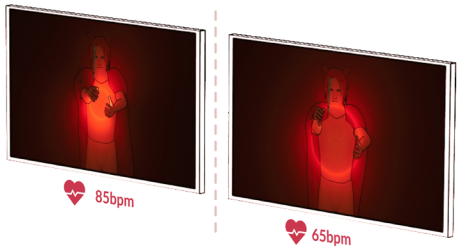
Horn part of the AR glass is interchangeable. Therefore, players can use different horns for activating different skills.

Unicorn Experience is an AR glass that has a unicorn horn extension. The game played by hitting the certain targets scattered around the augmented environment by reaching them with the unicorn horn. It also has social features such that some targets can only be destroyed when two players with specific skills come together. Here, we can observe that Unicorn Experience plays on the Mid-Distant interaction of **SOC** and Proximity of **INT** by bringing people together. Moreover, it also uses different horn extensions as a game mechanic corresponding to Mechanics and Customize themes of **COS**. It also affords users to perform action and reaction moves (**MOV**) by positioning the horn as an extension of the body!

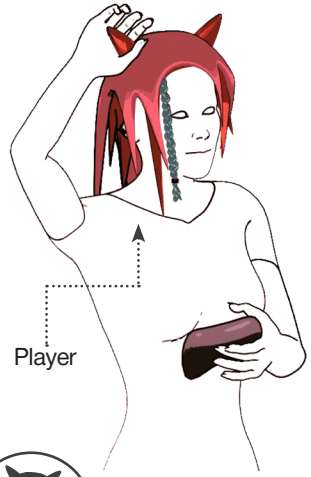


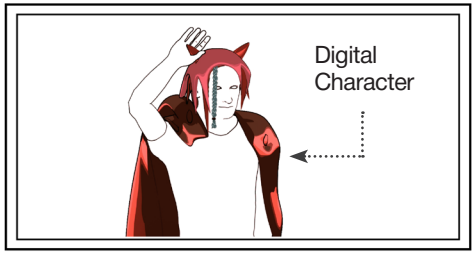
Glace emphasizes social interaction and self-expression. It is an accessory allowing players to see each others' gaming preferences and skills. As in the figure, one can understand that this particular player is currently playing Fortnite and see specific information such as character level or amount of resources. Aim is to engage collocated players with each other and facilitate social interactions such as "requesting resources as a gift". Glace, besides encouraging verbal social interaction, was also designed self-expression in mind and work towards the sense of belongingness. When associated with the key themes, Glace utilizes showing or hiding information to others which corresponds to the Hidden Info of **SOC**. Other than that, being designed only for collocated interaction, it draws on the Mid-Distant interaction. It is also a game interface that shows related in-game information which is a reflection of the Interface theme of **COS**.



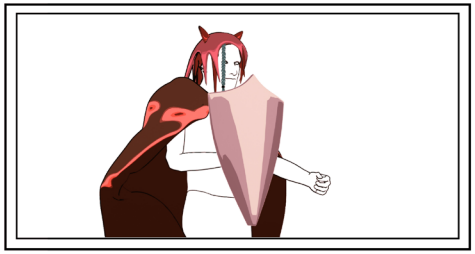


Different types of body data can be used as game mechanics. For example, when more excited, the character can run faster, or when calmer, a bigger fireball can be created





Different parts of the Head-On can detect touch and reflect it to the digital character. For example, when players hurl their hair or hold their ear, the digital character will do the same as means of interaction.



Participants also added other parts that can be used as buttons to trigger operational actions such as using the shield. When the player touches or squeezes the braid, the digital character brings the shield up.

Head-On is a wig incorporating an EEG system to collect the emotional state of the players and aims at transforming the players into the digital avatar by changing their appearance and transferring the body data to the game world. Different types of body data can be used as game mechanics. Furthermore, Head-On utilizes both the Expressive and Reaction moves extracted in **MOV** and does it by placing interaction points around the body (e.g. braid, ears) instead of using tracking technologies. It also heavily draws on costuming properties by emphasizing Mechanics and Customize in **COS**. In terms of bioadaptivity, it introduces Metaphoric and Physical of **BIO** by associating body data with skills such as casting spell (metaphoric) or sprinting (physical) and uses Mood of **INT** as an interaction method.

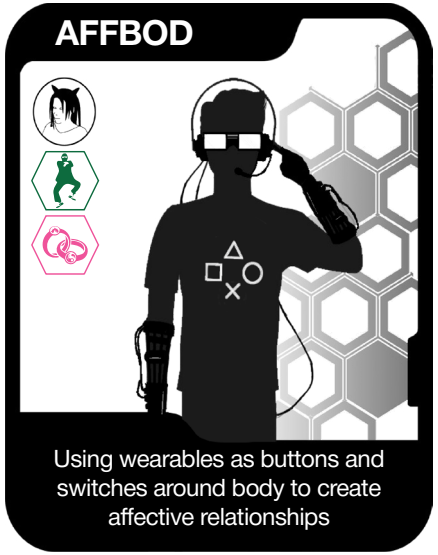
Although five concepts were created in **FUS**, we only present three. Omitted concepts, Gaming Sleeves and Jambourine did not propose enough novelty for contributing to our ideation process because Gaming Sleeves was a glove that detects bioadaptive data and proposes to integrate finger tracking to games which were tried many times by existing technologies. Jambourine was a gesture-based music making device and did not explore playfulness or games in depth.

DESIGN IMPLICATIONS

Key themes created in Atom Workshops were effectively incorporated into the concepts of **FUS**. Only exceptions were the Narrative of **BIO** and the Mediate of **SOC**. Although these themes encapsulate many interesting ideas, participants did not use them in the intermediary concepts. It does not mean that these themes are not useful, and we need to understand how they fit to the body of knowledge created throughout this process.

In this direction, by drawing upon the rich knowledge created through six workshops, we formed design implications for guiding the generation phase or our research through design process. Communicating design implications were found useful by previous studies because they provide abstractions of the rich design knowledge, which can be generative, generalizable and actionable [30]. However, it is also possible to lose the richness of the data if the implications are just summarized briefly in bullet points [11].

To avoid such simplifications, in this section, we introduce Implication Cards. We mapped the icons of key themes and intermediary concepts to these cards for giving a clear and easily readable picture of how the knowledge produced through the design process is transferred between phases. We also will demonstrate and discuss how they are related to the final concepts presented in the last part of the pictorial, giving concrete examples of their utility. In the remaining of this section, we explain implications by also drawing on the previous work in the field.

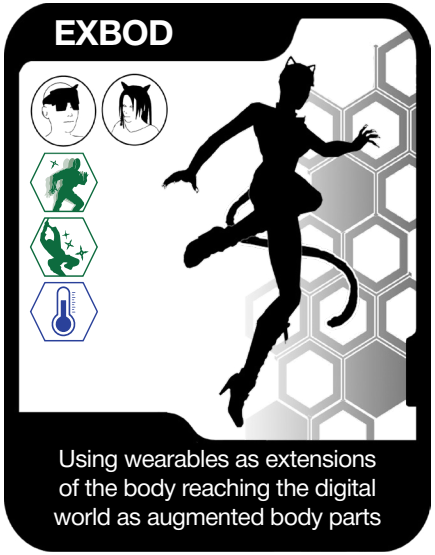


Affective Embodiment (AFFBOD)

Wearables can create affective interaction opportunities by combining tangible and bodily actions. The ideas raised in Mechanics of **COS** and Expressive of **MOV** were translated into the Head-On that utilizes wearables as a tool for in-game expressiveness through tangibility. As indicated by Tanenbaum & Tanenbaum [33], wearables can turn the body into a surface for switches and buttons. Here, we propose that these switches and buttons can create affective relationships with game avatars and other digital beings through distinct affordances for embodied interaction (i.e. feeling of touching the ear of the in-game avatar). Thus, wearables can be a way to design somaesthetic experiences through guided tangible interaction by being placed in the specific parts of the body [19]. This can also be used as in-game challenges, for example, players may have to swap the positions of the objects embedded in their bodies.

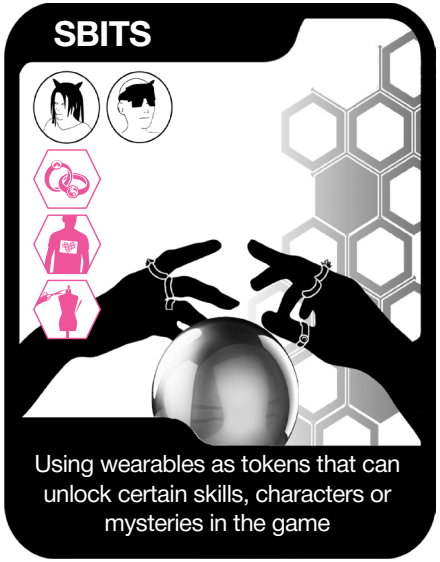
Belongingness (BELONG)

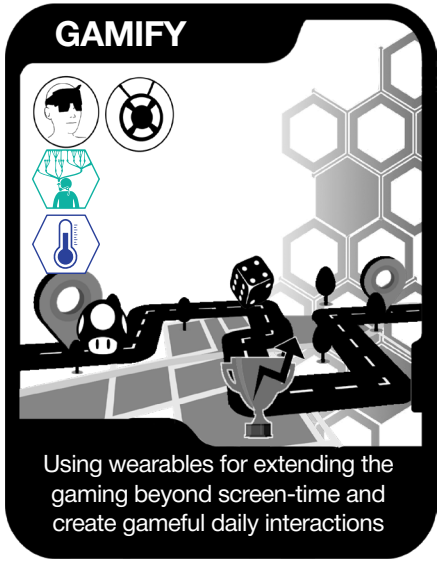
Sense of belongingness that was introduced by Glace can be a promising implementation for wearables for mainstream games. Dagan et al. tried using wearables that shows alignments to teams in a LARP context before [9]. Moreover, belongingness was explored before by Tajfel showing with various experiments how even small and meaningless distinctions to define groups can lead to in-group favoritism or favoring of the own group versus the other group [32]. As mentioned in the Customize theme of **COS**, mainstream games might benefit from having different customizable skins according to players' teams which may strengthen the sense of belongingness to this team by providing a chance to represent the team also outside the games, for example in e-sports context. These "kits" can also be used for data collection that may help evaluate the player performances.

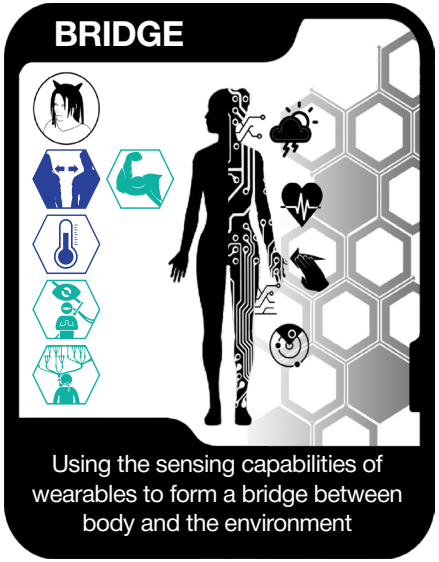


Extended Body Affordances (EXBOD)

Wearables can extend the body and change the way players move depending on these extensions. Unicorn Experience is a remarkable example of using the actions mentioned in Actions and Reactions in **MOV** in a novel way by creating operational moves centered around the horn extension. As mentioned in Environment of **INT**, these extensions can interact with the environment leading to movement affordances that otherwise would not be possible to create (i.e. using your head to hit the digital environmental cues in Unicorn Experience). Therefore, wearables can change kinaesthetic perception of the body, but they can also define and help build the proprioception in the virtual space. In that sense, understanding the virtual counter parts of the physical extensions of the body can create opportunities for designing game mechanics especially for Augmented and Virtual Reality environments.







Skill Bits and Pieces (SBITS)
All themes in **COS** introduced methods and modalities, that consider wearables as artefacts that can represent the "superpowers" of avatars. In that sense, even "(not) wearing" the device becomes an interaction modality which may activate or disable certain skills in these two different states. Head-On and Unicorn Experience projects also proposed similar ways of adapting skills according to different versions of the worn artifacts. They can also be immersive interfaces that introduce touch, gestural or tangible interaction to use the skills of the avatar and the way of interaction can even be introduced as a challenge. Previously Magia Transformo [20] and WEARPG [7] explored wearable attachments corresponding to skills however they did not deeply explore how they can reflect to mainstream gaming. In this pictorial, we demonstrate a few examples of possible uses in the Final Concepts section.

Collocated Sociality (COLOSOC)
All themes of **SOC** focus on different ways of providing collocated social interaction which also refers to Proximity created in **INT**. Albeit game mechanics proposed in **SOC** were not explored deeply in **FUS**, Glace was built on collocated verbal social interaction and self-expression. A similar concept has been explored by Marquez et al. in the LARP context and found to facilitate improvisation and in-game conversations [25]. Here, we add to this knowledge by proposing types of information that can be publicly shared in the context of mainstream games. Other than Glace, collocated social game mechanics were also introduced by Unicorn Experience where proximity of players affect the outcomes of the game. These outcomes show that collocated social interaction can create new social paradigms while playing games such as a multiplayer console game where keeping/changing the proximity between two players influences gameplay.

Gamified Applications (GAMIFY)
Our findings in the Environment of **INT** suggests that more precise detection of environmental cues may be a strong contribution to design of games that spreads to the other parts of our lives and ideally enhance the effectiveness and experience of daily activities. Ideas in Narrative of **BIO** provide insights about how to extend the games in mainstream gaming platforms beyond screen by gamifying daily physical activity. In **FUS**, Unicorn Experience, and Glace also mainly draw on the scenarios applying to daily life of gamers. Thus, besides the sense of belongingness, extending the capabilities of wearables beyond screens for gamifying our daily lives can be another solution towards making them more adoptable. However, while considering wearables as a part of the daily clothing, fashionability [15] and wearability [13] should be carefully considered in the design process.

Bridging Self and Environment (BRIDGE)
"Sensing" was a prevalent theme across all workshops. **BIO** introduced variety of methods for integrating body into the games by showing movements and bio-signals that can be collected from different parts of body may be meaningfully integrated into games. Additionally, **INT** and **SOC** emphasized the importance of sensing the surroundings of players. Where to Wear [36] body mappings provide quite extensive information about how to design wearables for the different parts of the body and our themes. Concepts and themes presented in this paper expand this towards gameful experiences by using the wearables as a bridge that can connect the body to its environment. In that sense, the connection between bodily modalities (i.e. heartbeat, movement) and environmental cues (i.e. temperature, physical objects, other people) can be bridged through wearables and used as a game element.

FINAL CONCEPTS

Seven design implication cards presented in the previous section were created by aiming at reaching readable, actionable and usable design knowledge that is created by analyzing fifteen design themes, three intermediary concepts and their relation to each other, previous work and mainstream gaming. These cards guided our design process in two-ways:

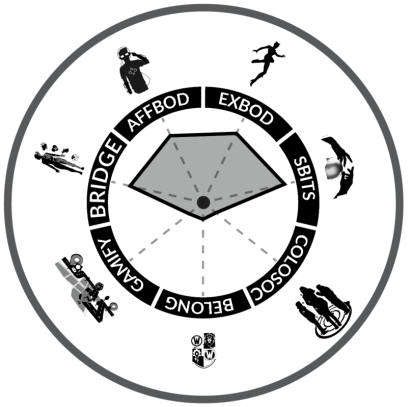
1) They showed the main design directions that can be used in the concept generation. This also allowed us to evaluate our concepts by using implication wheels, determining the relation of them to implications and discover the under-explored parts of the wheels.

For example, after realizing that Belongingness (*BELONG*) and Gamified Applications (*GAMIFY*) cards were used less than others, we wanted to elaborate this part of the wheel which led to designing the smart watch module of Gaming Core, with regards to self-expression and beyond-screen time. It also came as a solution to the demanding process of wearing and taking-off the device only for gaming by being a concept that is meant to be worn also outside of gaming moments. Thus, visualizing the design knowledge before progressing played an important role in the concept creation phase of the design process by demonstrating us the possible avenues for expansion.

2) Cards are also clear indicators of which key themes, intermediary concepts and thereby possible gaming ideas were a part of the specific implications. Thus, it eased going back and forth for reading the details of themes or the concepts during ideation process.

For example, although Gaming Cloth adheres 4 of the design implication cards closely, it introduces a dynamic cloth concept which is generated while trying to understand the possible wearable concepts under-explored by participants. It is an interesting example showing that every bit of design knowledge can be inspiring and important for designers and therefore while reporting research through design processes, it is critical to convey in-depth knowledge as also suggested by Zimmerman et al. [38].

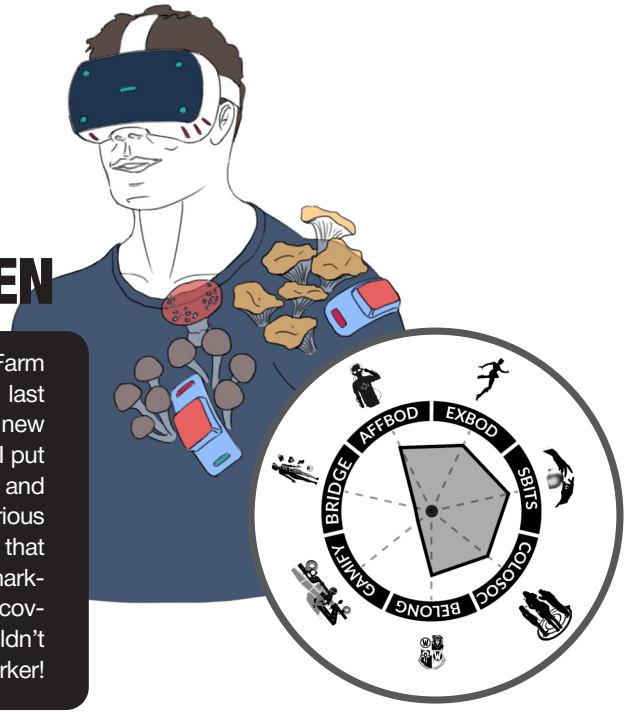
In this section, we present our *own* final design concepts generated based on the design knowledge produced in our process. Each concept has an implication wheel showing the relation to implication cards and presented through fictional scenarios which is an effective way to convey user possible user experiences to readers [4,5].



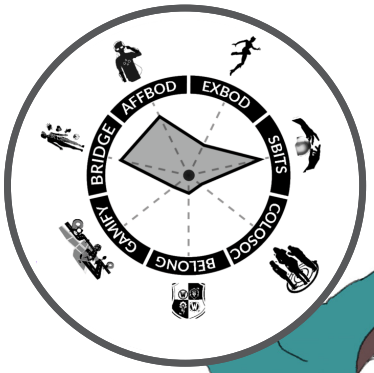
GAMING CLOTH

When I see Gaming Cloth, I was quite intrigued by this fabric-based wearable, but also a bit skeptical about its usefulness in games. I first tried Gaming Cloth with a computer role-playing game. The game was specifically designed for the Gaming Cloth and you could use it in many ways. For example, if you cover your body against an attack it was behaving as a shield. If you wrap it around your arm after you are injured, it turns into a bandage. I was fascinated by the idea that you can turn different parts of your body into a gaming surface **(AFFBOD)** and you can even use it as an extension of your body **(EXBOD)**, for example by wrapping it around your head similar to a tentacle. It's basically gaining new skills **(SBITS)** depending on where you wear it. It also has body sensors in specific positions **(BRIDGE)**. For example, if you wear it as if a Wizard Cloak, it senses your heartbeat and if you can stay calm, you can become invisible as long as you can keep your calm. Gaming Cloth is an interesting product that completely changes how I can incorporate my body into games. Yet, currently there are not enough games that support it and hopefully more will release soon.

FUNGILAINEN



Yesterday, I put my VR glasses on to check what is going on in my Body Farm **(EXBOD)**. I wore my Fungilainen T-shirt that had the markers I placed last week. After Fungi Vision was activated I was quite surprised to see that a new mushroom specimen has grown due to the interaction of other markers I put on my cloth. I placed another marker on this new specimen to capture it, and go out to see if anyone would want to trade **(COLOSOC)**. I was also curious about the kind of powers it will give me **(SBITS)**. In the street, I realized that one of my markers had gone red and I saw that another player with the markers of the Red Team **(BELONG)** was trying to capture it. I immediately covered my two markers **(AFFBOD)**, yet since I don't have three arms, I couldn't prevent my opponent from stealing the mushroom in my unprotected marker!

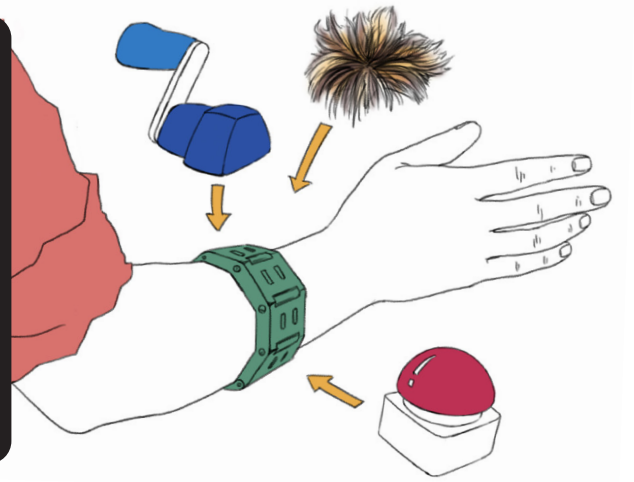


TANGICUBES

Oh, I got a hit! My red tangicube is flashing. I took it from my arm, brought to my mouth and drank an health potion **(AFFBOD)**. Certainly, it is easier to do that just by pressing a button, but this version creates a nice challenge. I am putting this back so it can refill my health potion for the next usage. Good, I could deflect this attack successfully. OK, now I will sneak behind these enemies, and I will throw a bomb. I need to throw my soft Tangicube **(SBITS)** to the screen and hit those creatures to successfully take them out. I really like how these cubes interact with my environment **(BRIDGE)**. OK, I hit them! Next target, I will throw another Tangicube. Oh no! I forgot to take my cube from the ground, let's take... Oh they saw me aand I am dead! I hate these cubes!

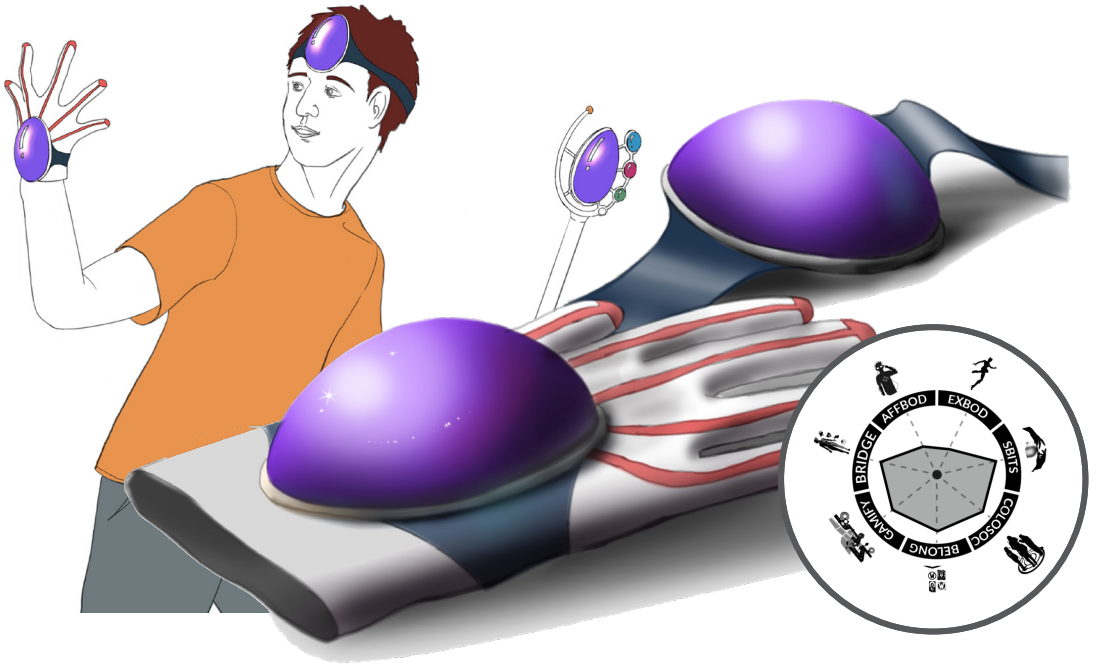
INPUTS

Now what? I think I need to put this crank to my arm! Ah, look my arm turned into a fishing rod! **(SBITS)** Great, let's swing it **(EXBOD)** to catch some fish. Oh, it vibrates, I'm turning the crank and it comes. What does it say? To see the fish, attach your furry module! Furry Module? OK. Oh, it vibrates like crazy. What? A sea otter bit my arm and I needed to pat to calm it down! Little sea otter, I am patting you don't get angry **(AFFBOD)**. Ah, now it's my friend and will help me in my journey. Cool! It's really nice to have a furry sea otter companion in my arm but I wish I wouldn't need to plug new modules every now and then. It should be somehow automatic!



GAMING CORE

Today I met with someone who has a Gaming Core when I was hanging out in University's Game Club. I had my Mass Effect watch cover and she has the Psychonauts which actually is my favorite game so I had to ask **(BELONG)**! We had a great conversation and decided to play a game. We started the game and my daily activity **(BRIDGE)** increased my space knowledge skill **(GAMIFY)** while her daily activity boosted the intelligence of her character **(SBITS)**. We played for a while and our new skills really worked well and helped us in our gameplay session. After, I asked her if she would want to exchange the watch covers **(COLOSOC)**. She said that she really likes Mass Effect but space knowledge does not really work for her character. I wish we could change the skills these watch covers provide instead of buying a new one for each skill!



REFLECTIONS ON FINAL CONCEPTS

Through the fictional scenarios depicted, we highlighted the possible user experiences which can be evoked by the final concepts we design and connected them to the design implication. In this section, we will reflect on the possible avenues these concepts can expand to by elaborating these connections.

Gaming Cloth is a fabric-based gaming wearable. As suggested in Affective Embodiment (AFFBOD), wearables placed in the different parts of the body can guide the body movements with buttons and switches [33]. However, Gaming Cloth facilitates the same characteristics by relying on the material qualities of the fabric. For example, players can take on a protective posture while covering themselves with the cloth to activate the shield skill also referring to Skill Bits (SBITS). It can also be used in ways which extends the body boundaries as suggested in Extended Body Affordances (EXBOD) (i.e. wrapping it around the arm for extending the arm) and also collect body and environmental data through sensors to transfer it to the game Bridging the Self and Environment (BRIDGE).

In **Fungilainen**, AFFBOD is provided by markers because players need to interact with them, for example covering to protect it from others, and extensions of the body, the mushrooms, exist in the virtual world by exemplifying another way to incorporate EXBOD. It also adds a social layer to the gaming world by envisioning Collocated Social Interaction (COLOSOC) where people can steal or exchange mushrooms while the same colored markers represent alignment to different global teams, as inspired by the Belongingness (BELONG).

Tangicubes, adopts a literal interpretation of SBITS and AFFBOD by placing tangible bits around the body which, then, needs to be interacted by touching, throwing or dragging them to the different parts of the body. The gameplay sequence depicted above also shows a possibility where Tangicubes interact with the environmental objects (i.e. targeting and hitting the content on the display) by referring to BRIDGE implication.

Inputs concept is heavily shaped by AFFBOD and EXBOD because it extends the body with different kinds of modules and the interactive affordances of those modules (i.e. cranking, pressing, petting) lead to affective interaction methods with the body. It also uses the notions of SBITS since each module attached to the device enables players to perform new skills in the game.

Gaming Core is a smart watch that can be turned into a gaming device by being attached to game props such as gloves or wands. In this sense, it draws on BELONG as an expressive wearable with which players can reflect their gamer identity in daily life. This feature needs further envisioning on the fashionable aspects of Gaming Core since an attractive look that can fit to the clothing style is a critical part of wearable design [15,34]. It also adopts Gamified Applications (GAMIFY) implication by collecting daily physical activity data and integrating it into the game such that it boosts the in-game skills (SBITS). It also facilitates hiding personal data or sharing expressive data with others, as suggested by Social Wearables Framework [10], and leads to a collocated social interaction (COLOSOC) between players who own the Gaming Core.

CONCLUSION AND FUTURE WORK

In this paper, we illustrated the design process of gaming wearables, starting from participatory design workshops to concept creation. We try to illustrate every step of the process as detailed as possible since, in research through design projects, it is critical to reflect the process in detail. In this way, while other designers and researchers could follow our process, they can also try to discover different paths by starting to explore through different phases.

In our process, most of the key themes were incorporated in the **FUS** concepts. However, generalizing those and administering in the generation process resulted in quite versatile design outcomes that touch on the different implications cards in many different ways. In research through design projects, it can be hard to communicate and process the connections between different phases and understand how the design is evolved. We believe that the gameful visualization method we have used is an effective way to demonstrate and also understand how the design knowledge created in different phases can be transferred to the creation process of designers. This also helps understanding the usefulness of user input in the practical design phase. Other than that, using fictional scenarios to present final outcomes is beneficial both for depicting clear user scenarios but also for reflecting possible problems and detrimental effects on the user/player experience. In this direction, we believe that the design process we conveyed here will be helpful and an exemplar for presenting research through design work.

For the future work, our plans include developing the low-fidelity prototypes of the final concepts illustrated here. By doing this, we want to understand how players will see the benefit of those wearables created through a participatory design process. Understanding the stance of users around these different interaction modalities will help us to formalize design guidelines that can lead to high fidelity prototypes which will shape the future of gaming wearables.

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