TANGIBLE COMMUNICATION

Designing Physical Expressions of Indoor Applications

FMP Preparation Project Report 2020

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EXECUTIVE SUMMARY

As the era of ubiquitous computing unfolds, many have explored divergent approaches to support human-computer interactions, resulting in various types of interfaces but yet some of them are being disruptive to the balance between humans and technology.

In this project, the design opportunities for the integration of tangible interfaces in Smart Homes are explored. It mainly investigates and compares different types of interfaces, together with multiple interaction frameworks to define the design direction, design rationale, and fields of application. Consequently, this project proposed three interfaces that integrate system control and outputs, allowing users to have different degrees of control while reserving system's intentionality or expressivity.

This report first demonstrates the author's vision and identity as a designer and later elaborates them through the project by describing his design-research process, conceptualization, and future plan. Above that, a personal reflection on the project and learnings are included.

IDENTITY

As the development of technology has been increasing tremendously over time, robust functionalities have been incorporated in new products and systems. We have become more connected to the world and other humans than ever before due to the leverage of ubiquitous computing. However, to some extent we are also being both manipulated and restricted by technology. We are being passively fed with overburden information; Our everyday life could be easily disrupted by various sources of digital distractions; On the other hand, we become more often occupied by the digital world for example mobile phones instead of the physical world. We humans have excellent sensation and abilities to manipulate our everyday objects. Yet, this hasn't been entirely leveraged.

At this moment, the market-ready smart devices are usually intangible information based. They usually employ texts, graphs, speech-voice to convey messages; Similarly, ubiquitous computing exploits different types of sensing (e.g. IR, temperature sensing, etc), which allows computational data to be silently collected from the surroundings in a person's background. However, despite these types of data are able to convey rich capacity of information, they either demand a person's relatively high cognition for perception and interpretation, or lack direct perceivable affordances. Giving them an appropriate physical representation might allow humans to directly interact with digital matters and therefore achieve the transition between the physical and digital world.

To achieve so, I envision a concept named tangible communication which aims to couple peripheral interaction and tangible bits. By leveraging the composite of human's sensation, intuitive bodily movement (e.g. Topplr [20]) and tangible displays (e.g. PneUI[17], InFORM[4], Shape-changing Bench[7], Relief[8], a novel way of Human-Computer Communication through material might be possible. This might bring the HCI or Interaction Design the possibility of creating a sensationally rich, intriguing and less obtrusive experience.

VISION

With the tremendous development of technology, ubiquitous computing is nowadays becoming increasingly incorporated in new products and systems. It provides us better connectivity to the world and the people, allowing us to fetch news and updates from our circle of friends effortlessly. However, to some extent we are also being manipulated and contained by technology. We are being fed with overburden information, which makes us passively accept recommendations from intelligent systems; Also, our everyday life could be easily disrupted by various sources of digital distractions. On the other hand, we become more often occupied by the digital world for example mobile phones instead of the physical world. The fact is that we humans have excellent haptic sensations and manipulating skills with our bodies. Yet, this has not been entirely leveraged on the major interfaces we are interacting with.

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Based on that, I develop my vision named tangible communication (see figure 1, placed at the center of Pi) which aims to couple peripheral interaction (bottom-left circle) and tangible dynamic interface (bottom-right circle). By designing interfaces that leverage human's sensation (e.g. haptics), intuitive bodily movement (e.g. Topplr [24]) and tangible dynamic displays (e.g. PneUI[21], InFORM[4], Relief[8] , etc), the way humans communicate with interactive systems might consequently become tangible, experienceable and reciprocal. The design outcomes might serve as Research through Design (RtD) cases for researchers and designers in the field of HCI.

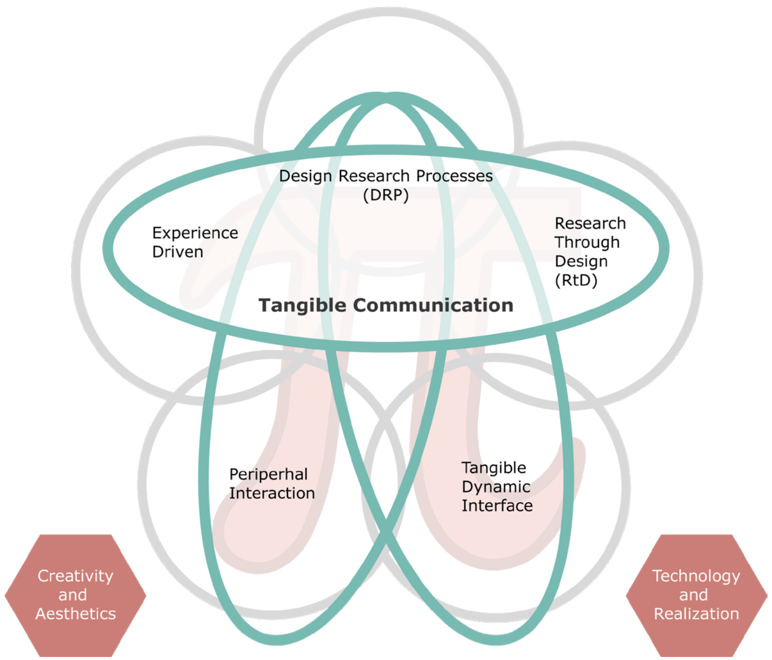

Figure 1. Pi diagram of identity and vision

INTRODUCTION

In the past decades, researchers from the field of Human-Computer Interaction (HCI) have been investigating how humans and machines understand each other, resulting in divergent means of communicating such as via texts, visuals, voice, etc. This is due to the fact that humans and machines are using different languages in communicating. Machines might rely heavily on digital information, whereas humans may employ vocals, gestures, facial expressions, etc. Such out of sync ways of communication may result in insufficient and delayed communication.

As humans are so much capable of sensing and manipulating matters in the physical world, but this has not been fully leveraged. Recent research has shifted to explore the possibilities of making object's physical properties interact-able with sensors, actuators, or programmable materials. Based on this trend, [5] pictures that in a predictable future we will not only be surrounded by ubiquitous computing, but also be able to interact with the graspable representations of them. This leads to a question: what would Human-Machine communication be like in the future?

In this FMP Preparation, I proposed a concept named Tangible Communication, which refers to having communication between humans and machines built via tangible but dynamic objects (e.g. shape displays). Compared to other modalities haptics is the only sense that is reciprocal [3]. Therefore, it has the potential to take full advantage of human's perceptual-motor skills and ultimately to serve as a compensation for interfaces that are vocal-based, visual-based, or audio-based modalities.

BACKGROUND

In 1997, Weiser and Brown addressed the challenge of designing calm technology for the emerging era, ubiquitous computing, from which they stress the need to stay in control of the technology that would surround us and prevent us from information overload by digital devices. Many have built upon this vision, resulting in various explorations of approaches to leverage the capability of technology while also containing its consequential obtrusiveness.

One early exploration focuses on seamless integration of digital bits in the physical world. In 1997, Hshii and Ulmer introduced Tangible bits [6], a concept in which they seeked alternative means of interactions other than GUIs. They augment objects from the physical world as interfaces with the coupling to the digital world namely Tangible User Interface (TUI), which is to compensate for the lack of natural affordances of GUI ones. However, as TUI is often being constrained by its static physical form, to further disclose the potential of being tangible, Hshii further proposes the concept called Radical Atoms [5], which envisions to attach physical representations for every bits from the digital world, allowing humans to seamlessly and directly manipulate the digital world.

Another a bit recent exploration stresses on the level of required mental effort of interactions. Specifically, continuing upon the divided attention theory [9] (a theory addressing attention as the division of mental resources over different activities [2]) and multitasking theory [26] (which stresses on the mental resources can be allocated on different tasks), Saskia proposes interactions can be categorized and distributed on a continuum [15] from focused, peripheral, and implicit interactions with identical characteristics. She believes by leveraging peripheral interactions to bridge the gap between two extreme sides on the continuum (focused and implicit interactions respectively) is a way to reduce the obtrusiveness of our everyday objects.

Besides, due to the emergence of Artificial Intelligence (AI), Voice User Interface (VUI) [16], an intangible interface, in the form of Virtual Assistant, is introduced - and has been made popular by Siri [1]. It is also seen as the embodiment of humans, initially allowing users to fetch information (e.g. weather, time, navigation) and nowadays offers users rich and explicit control over the connected devices. Most of the VUIs mainly rely on speech-sound, to perform certain control, a user has to memorize the vocal commands. Consequently, physical buttons are usually eliminated from these interfaces.

METHOD

Overall, a Research through Design (RtD) method is (will be) applied [4]. For this preparation project, the executive emphasis is mainly addressed on explorations, reflections, ideations and construction. First, explorations and reflections of design precedents (as well as unpublished design projects) are conducted to help understand what has been done and reflect on what can be improved and implemented in this project; Second, a reflected rationale of design is generated together with consecutive expert review are conducted to ensure infant ideations are on the right track; Then, ideations with research potentials are developed in forms of functional prototypes as well as mandatory software and hardware infrastructures. This is to ensure smooth user studies in the following .

RELATED WORK

Living with Smart Home

As Internet of Things (IoT) invading modern homes, more and more smart products have been brought to the market and deployed in our homes or home-alike contexts. Most of these devices and services are usually controlled by VUI [16] in the form of Virtual Assistants which allow users to prompt questions and control the system. The three most prominent competitors in this field are Google Home[27] Alexa by Amazon[28], Siri by Apple [29]. Also most of these smart products (e.g. Philips Hue [30], Smartmi Air Conditioner [31]) are accompanied with Graphical User Interface (GUI), in which users can have explicit control over the parameters of corresponding applications. Taken together, Flyzoo Hotel [32] (see figure 2), a hotel almost entirely run by robots, presents a highly integration of the above mentioned elements or alikes, bringing users a sense of futuristic home. Yet, interfaces served on these products or services are usually voice- or visual-based and to understand them, intellectual-motor skills are mandatory. As a result, performing interactions through these interfaces would demand users to shift their center of attention onto them [15] or their intellectual-motor skills.

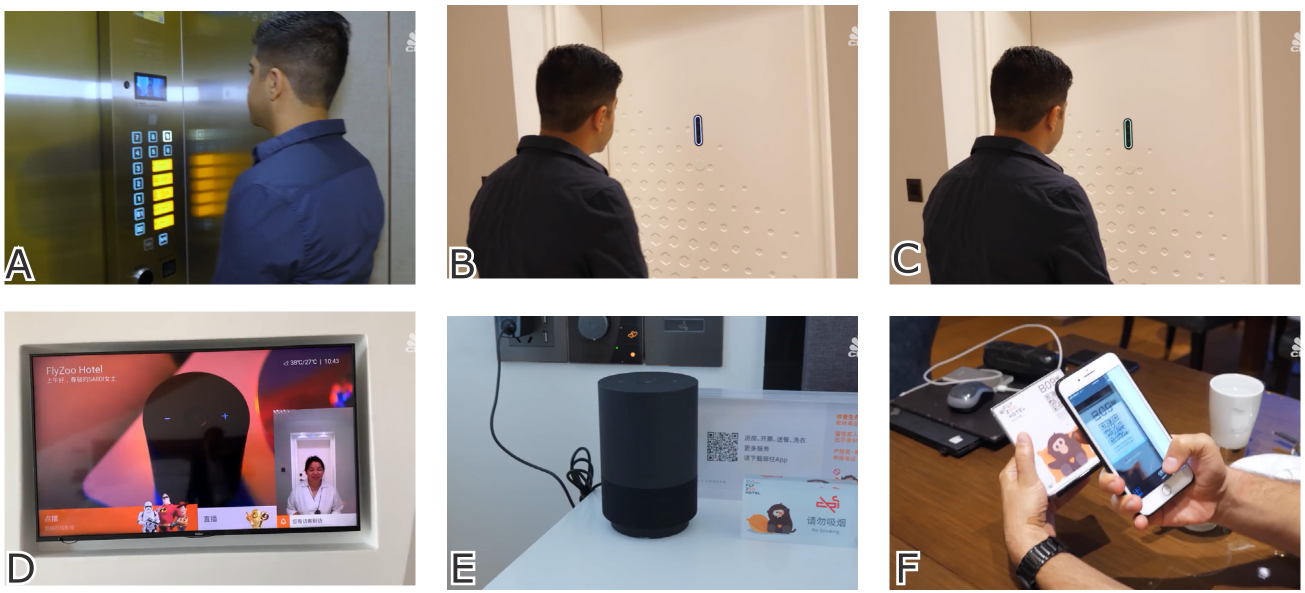

Figure 2. Flyzoo hotel, [A-C] using facial recoginition for hotel elevator and room access; [D] using camera-monitor to check visitors; [E]using virtual assistant to order food or control IoT devices in the room; [F] using a mobile phone to order meals

Peripheral Interaction

Peripheral Interaction initiates from calm technology, aiming to offer effortless control of the computing system or present information subtly which allows users to perceive in their periphery of attention. An early example developed by an artist, is the Dangling String [19] (see figure 3), a live wire connected to the ceiling that subtly wobbles itself to inform office workers' the network activities. Similarly, Move-it sticky notes [22] (see figure 4), an mechanism that actuates office sticky notes by adding motions to subtly notify users of their upcoming tasks. More recent examples include Topplr [24] (see figure 5), a music controller which allows users to skip a song by tumbling down and Breathe-in [33], exhibited at the Dutch Design Week 2019, allowing users to skip a song or flip a page on an e-reader by holding a breath for a certain duration. However, it seems these interfaces by far only emphasize on their inputs or outputs. For instance, there is no way for Topplr to output information in one's periphery of attention as Dangling String, and vice versa. Besides, despite the fact that Move-it incorporates both outputs (subtle motions) and inputs (setting reminders), writing and setting a reminder still demand a person's intellectual-motor skills.

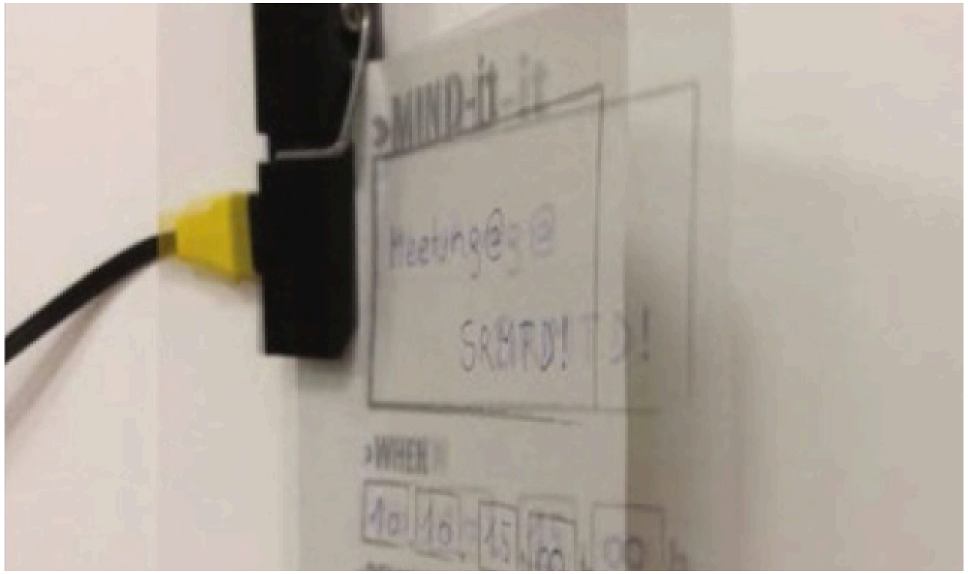

Figure 4. Move-it sticky notes: a electric-controlled peg where users can attach sticky notes with their upcoming tasks written on.

Figure3. Dangling String

Figure 5. Topplr, a peripheral music controller, allowing users to skip songs by tumbling it down (example of input-only interface)

Shape-changing/Haptic Interface

While iceberg (see figure 6, the analogy used in radical atoms [5]) keeps breakthroughing, many in the TUI field have explored overcoming the constraint of static forms of TUI, which populates shape-changing interfaces. One of which is inFORM [4], which transforms digital pixels into individually addressable pins with a beam on top projecting augmented elements (see figure 7). This demonstrates researchers the capabilities of shape displays: 1) provide physical affordances; 2) restrict behavior by adding constraints; 3) actuate movements; Researchers have also applied them to affect behavior, as the Thrifty Faucet, a shape-changing faucet [17] (see figure 8) which can turn, twist its head to different directions to propagate water-saving. The same as the shape-changing bench [7] in the public space (see figure 9), the bench actuates upwards to encourage people who sit in the distance to move closer to each other. Puffy, is a prototype (see figure 10) with a layer of fabric composite that changes its materiality by means of its volume when 'danger' occurs. Those shape interfaces mainly serve as system outputs to convey different messages while less focusing on how shapes (or force applied onto the shape changes) can act as system inputs, in [12]'s words, indirect interaction, adopting implicit input and shape-changing output (see figure 11).

Figure 7. Conducting user study with
a shape-changing Bench in the public

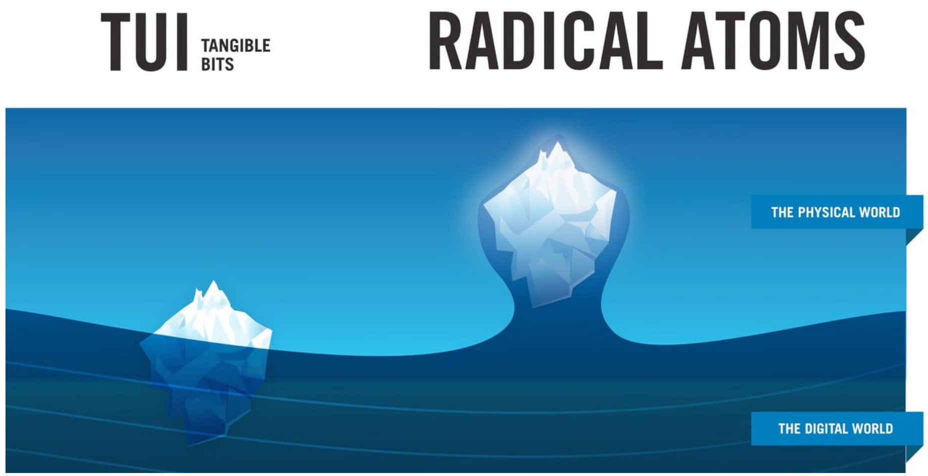

Figure 6. Iceberg, the analogy used in radical atoms

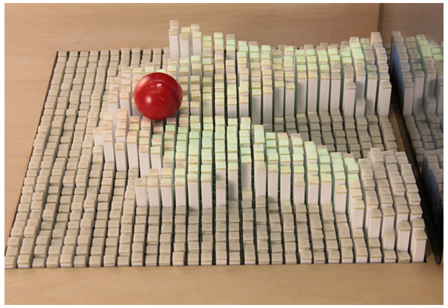

Figure 7. inFORM

Figure 8. Shape-changing faucet

Figure 10. Puffy

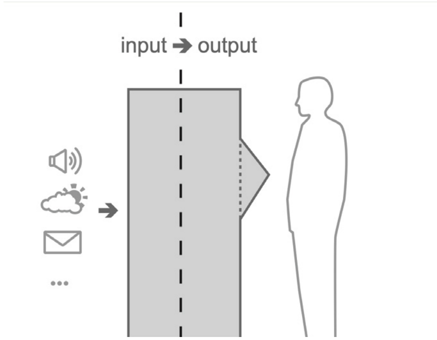

Figure 11. Indirect interaction with
Shape-changing outout

Shape-changing/Haptic Interface

To compensate for that, inFORCE [10] extends inFORM to detect and exert variable force on individual pins, allowing shape displays to give haptic feedback in response to the pin(s) which users press (see figure 12); Similarly, ReFlex [13] offers the possibilities for users to negotiate with the system by squeezing the shape-changing interface (see figure 13) and yet it also allows the system to react back; Also, Haptic Engine (see figure 14), a haptic know, not only allows users to input parameters to the system by rotation but also applies haptic feedback with dynamic friction while being rotated. Such shape-changing (or haptic) input and output based interactions allow users to communicate with systems reciprocally and tangibly, which enhances haptic experiences. Yet, such benefits have not been brought to everyday life.

Overall, by comparison and abstraction we learn that 1) the domain of Smart Home is mainly dominated by GUI- or VUI-based products [27–31] where intellectual-motor skills are actively involved. Rare TUI-based alternatives can be found; 2) it seems most of the peripheral interactions [19,22,24,33] address their peripheral-ness either on the system's input or output but not both; 3) Interfaces that leverage both shape-changing input and output have not been widely introduced to fields in our everyday life.

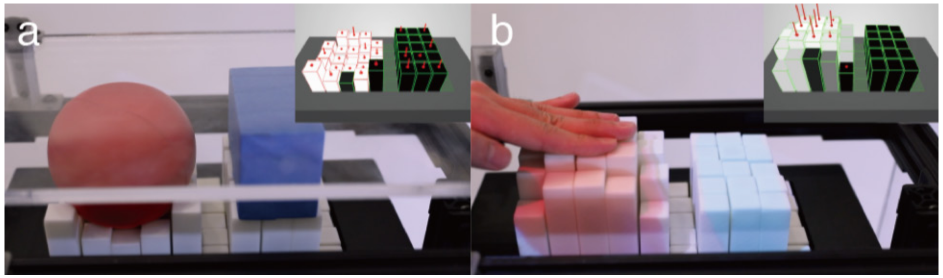

Figure 12. Scanning and replicating Shape, stiffness and appearance of physical materials. Red ball is soft and blue block is rigid. The top right images show the software that represents black pins as detecting rigid material, and white pins as soft material. (a:Scanning material, b: Replicating the captured material.)

Figure 14. Haptic Engine

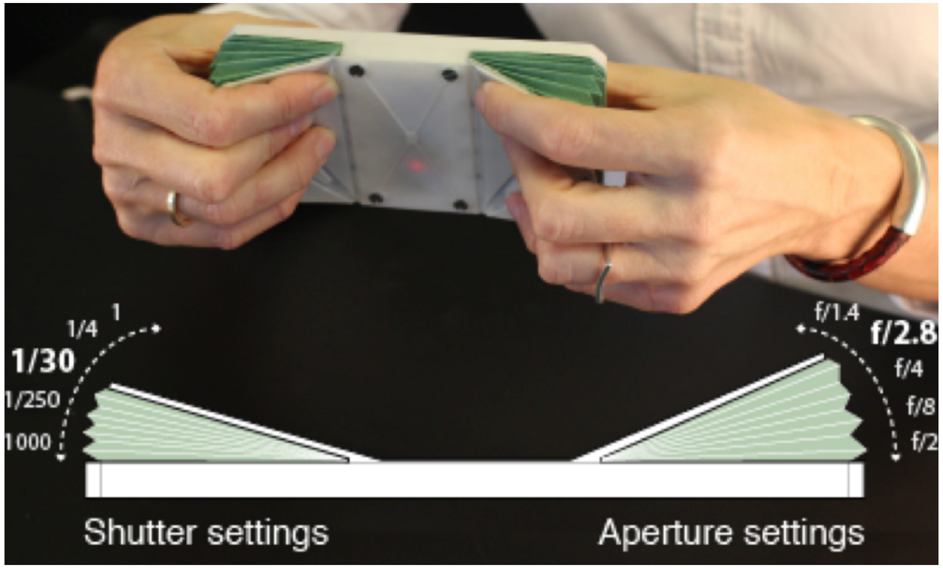

Figure 13. The system can negotiate with the user via the shape of the phone. e.g. the user can learn, reject, adopt camera settings from the interface.

IDEATION PROCESS

Based on the above challenges listed in the previous session, design rationale and ideations are explored. This is started by identifying and synthesizing what kinds of interfaces I aim for. To achieve so, I investigated models that previously discussed design cases (mostly peripheral interactions and tangible interfaces) grounded on, the Tangible User Interface model [6] and Interaction-attention Continuum [15] respectively. These two models both include information from systems and control that users own but articulate differently. The former one describes them as technical terms: input and output while these in [15] are described as direct/imprecise/no direct control and three interaction types for (system outputted) information processing; They also share dissimilarities as the former model describes in which way the interface exists while the latter addresses on the allocation of attention. Interestingly, such dissimilarities do not conflict with each other, implying the synthesis of these two models might be possible.

Synthesis and Inspirations

Taken both notions, a combined rationale (see figure 13) is described in a two dimensional table, categorizing interactions and user interface by the user's control, system output and involved attention on the horizontal axis, as well as the way they exist on the vertical axis. Since there is no clear segment of the human's center and periphery of attention, a grey area is set in between peripheral and focused interaction, which also applies to the User Interface column. For instance, [4,10] leverage both tangible and graphical user interface. Besides, there are also some newly incorporated keys: required skills; information type; type of attention. A brief explanation goes like this: as information type gradually shifts from knowing towards knowledge, required skills would consistently and correspondingly changes from perceptual-motored to intellectual-motored.

With such a table, it might suggest crossover designers or researchers, either from peripheral interactions or shape-changing field, a quick overview of the in-sync and in-different attributions between the two; it might provide hints what user control and system output could be incorporated on existing designs; It might provoke ideas such as, "what if everyday objects have autonomy, how would they communicate their intentions with users tangibly, haptically and obstructively?" For example, tangible output could have been implemented on Topplr [24] (e.g. self-tumbling) to subtly suggest users skip context-unmatching songs; Binary control could have been integrated on Move-it [22] to snooze the reminder by gently patting the shaky note using user's perceptual-motor skills.

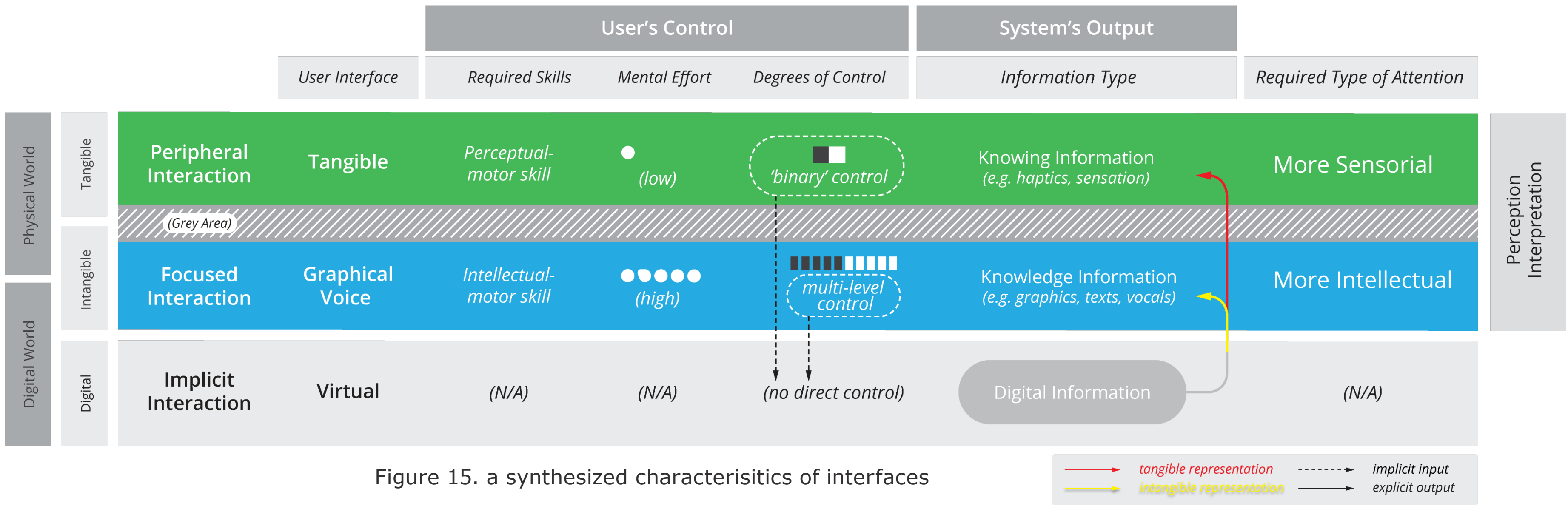

Figure 15. a synthesized characterisitics of interfaces

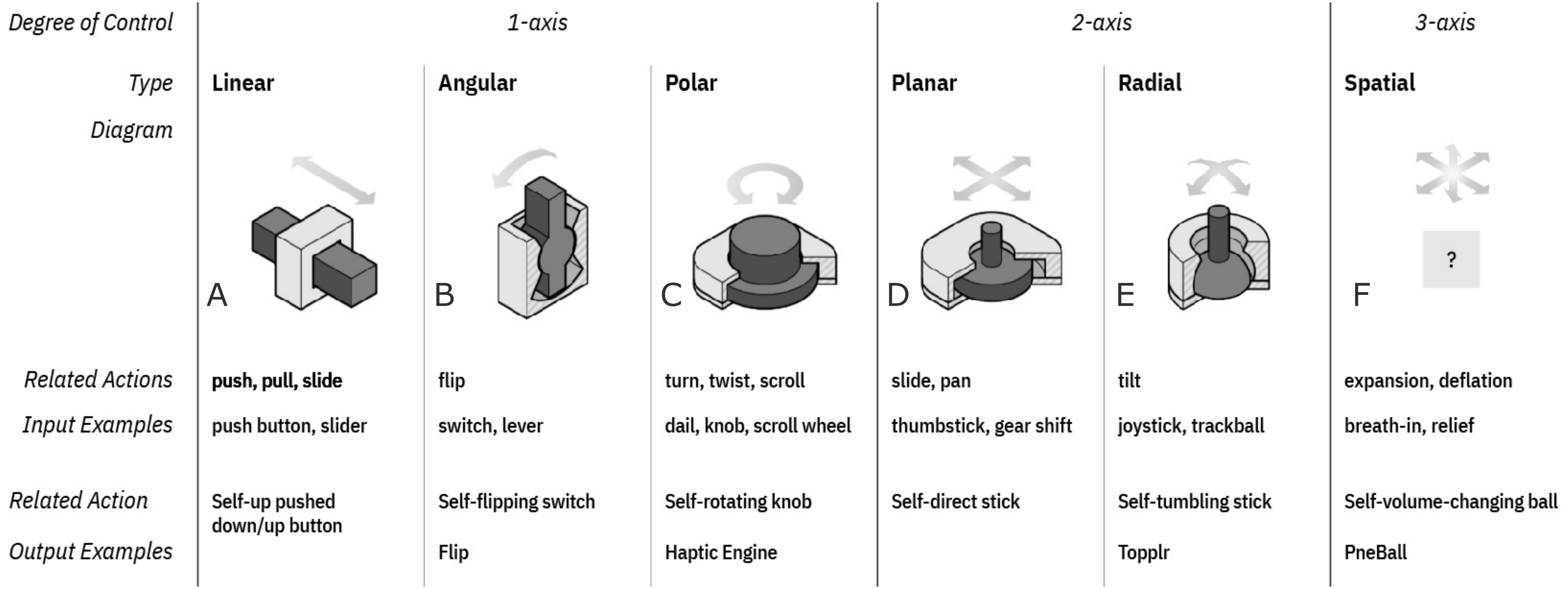

Figure 16. different spatial constraints with supported actions and examples of controllers (left from [1-5] are original, 6 is newly appened)

Ideations and Mechanism

To generate similar outputs as imagined above, mechanisms of tangible input derivatives are explored together with potential applications. Inspired by Mecha-magnets taxonomy [23], which covers five mechanical switches with different constraints namely Linear, Angular, Polar, Planar, Radial. Resembling ones are grouped to keep consistency with 'level of control' by the number of axis. Since from the prior explorations, some cases [8,20,21,33] are volume-changing or shape-changing which 3 axes are involved, so another subgenre spatial is included in the last column. Based on that, corresponding outputs for each sub-genre are explored and ideated (see figure 16). Haptic Engine has coincidently explored the polar column and for Topplr, it seems fit radial type but has yet implemented; In spatial column, few perfect examples are found but breath-in might have potentials to combine with volume-changing interface. Due to time constraints and conducting feasibility, only one from examples of each genre was selected and developed. They are 1) self-flipping switch: Flip; 2) self-tumbling stick: Topplr; 3) self-volume-changing ball: PneBall;

1) Flip

(self-flipping switch, 1-axis) consists of an actuation mechanism (powered by a DC motor) and a sensor (a potentiometer which reads absolute position of the rotator) on the lever. Such an interface operates as other binary (on/off) switch but it can also actuate by self-flipping. This may add some intelligibility to the switch. For instance, in this concept, assuming that Flip is context-aware, it knows when it is suitable to turn on the light and when it is not. The lever can flip outwards or inwards to suggest turning on or off the LED.

Implementation

During the process, as being limited by knowledge, the integration on both sensing and actuation motors was not found*. So I have had to develop a quick and dirty solution by hocking a DC motor on one side of the lever and a potentiometer on the other side. The motor is driven by an Arduino UNO Motor Shield and programmed by an Arduino UNO microcontroller board. The DC motor wobbles back and forth to actuate the lever when it detects a trigger (activated by the author). If the potentiometer reads an ON state, it turns on the LED and stops the motor; Otherwise, the LED keeps in OFF and motor stops.

Figure 17A. a mechanism consisting of a potentiometer and a DC motor

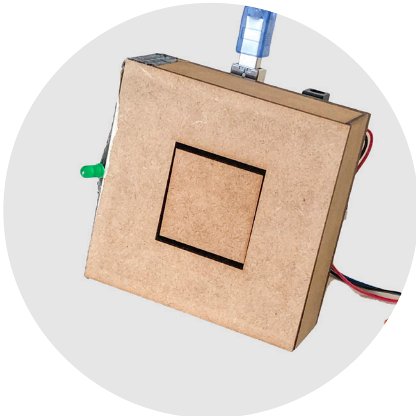

Figure 17B. Flip in OFF state

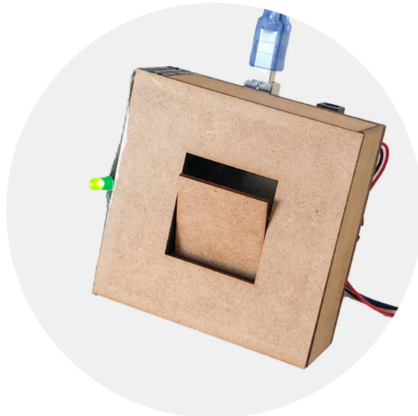

Figure 17C. Flip in ON state

* Even though I have conducted explorations and tryouts with divergent motors including (servos, step motors, DC motor) and made technical enquiry from d.search, no plug-and-play solution was found at that time.

* Luckily I was later informed that a TU/e Master's graduate (2017) implemented his Final Master Project named Haptic Engine [18]. However, his solution was a bit overkilling for my exploration due to the following facts: 1) more complex wiring configuration for a high-end brushless motor and a hall sensor; 2) each unit costs up to €100;

* On the During Demo Day, I was also suggested that I could use a motorized sliding potentiometer, a potentiometer that has a motor integrated, which can be contributing to the linear column.

2) Topplr: radial control

This is a non-electronic prototype made out of foam board for the Peripheral Interaction elective. It works as a tumble-able roly-poly which straightens up itself it is tilted, resembling a joystick. Such a property is leveraged to skip a song. As mentioned previously, Topplr could also have had subtle output as well. Thus, this project stresses on the implementation of that. Topplr can tumble itself down to notify users skip a context-unmatching song, as consistent as what it meant to be for the tumbling.

Implementation

the original prototype from the prior project was a mock-up for Wizard of Oz with no electronics integrated. Yet, such a prototype provides low feasibility to conduct a Wizard of Oz as there is no way to make it self-tumbling. Thus, a functional prototype is developed, which integrates a mechanism to alter the center of weight of Topplr; It is also a challenge to integrate multiple electronic components (i.g. DC motor, microcontroller, accelerometer) into a compact enclosure. Generally, a 3D printed mount is made to hock the RF300 Vibration Motor (powered directly by an ESP PWM port) on the top, a circuit composite (integration of ESP8266, AXL345 accelerometer, and a PCB board), and a RGB LED Ring attached on the bottom with an acrylic semi-sphere covered.

Figure 18. Topplr, non-electronics prototype

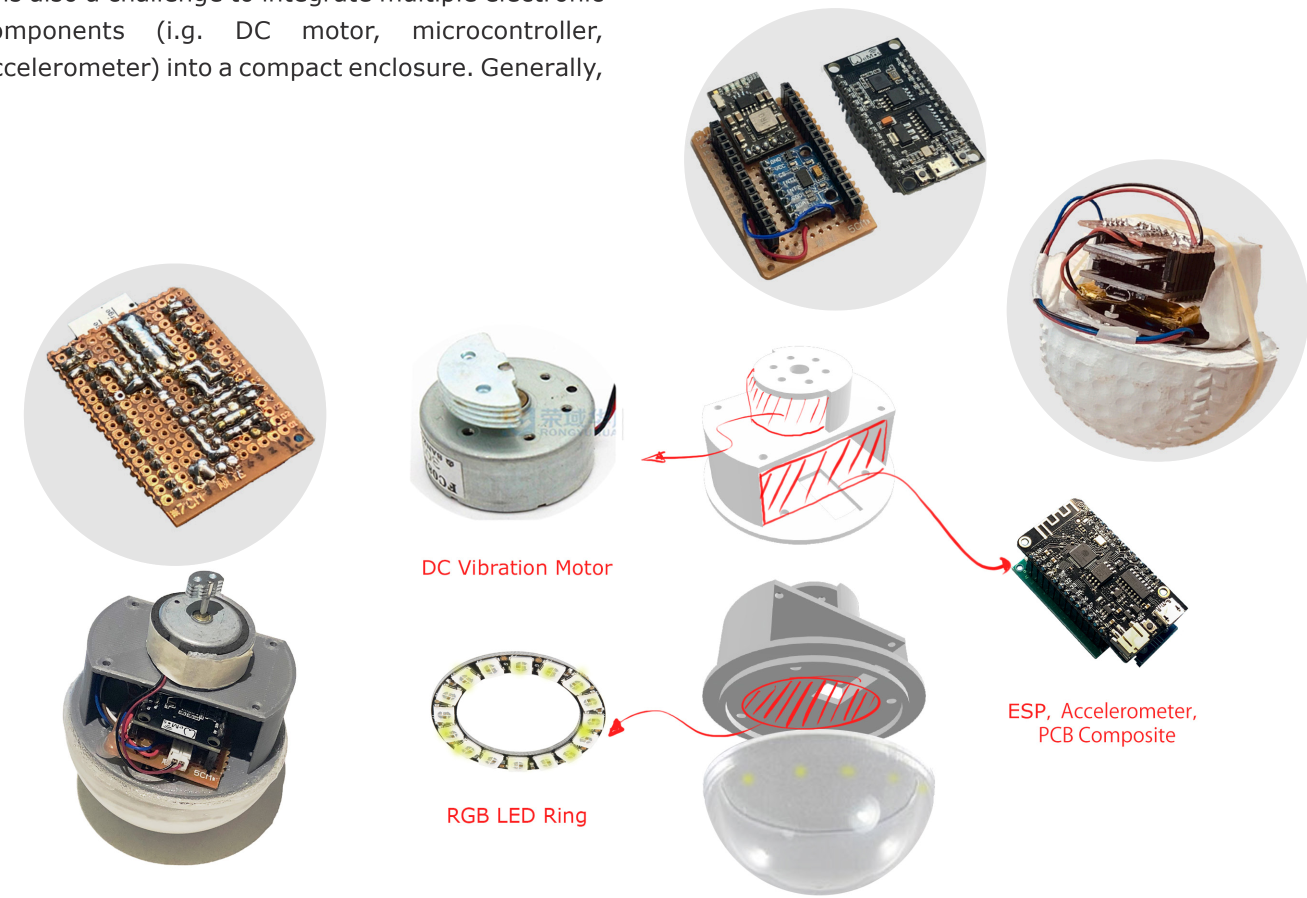

Figure 19. an explosed view Topplr with electonics developed in this project

2nd Iteration

From the 1st iteration, we experienced a CPU processing bottleneck as one HTTP request from ESP and Firebase [34] (a realtime database) would take at least 200ms and inadequate current from the I/O port. Thus, Wemos ESP8266 was replaced by Wemos LoLin ESP32 which supports dual-core processing, allowing CPU to execute web tasks and sensor & actuator simultaneously; AXL345 (3 Degree of Freedom) was replaced with MPU6050 (6 Degree of Freedom) to allow the detection of rotation; A Mosfet Driver, amplifying PWM signal, is incorporated to drive the DC motor.

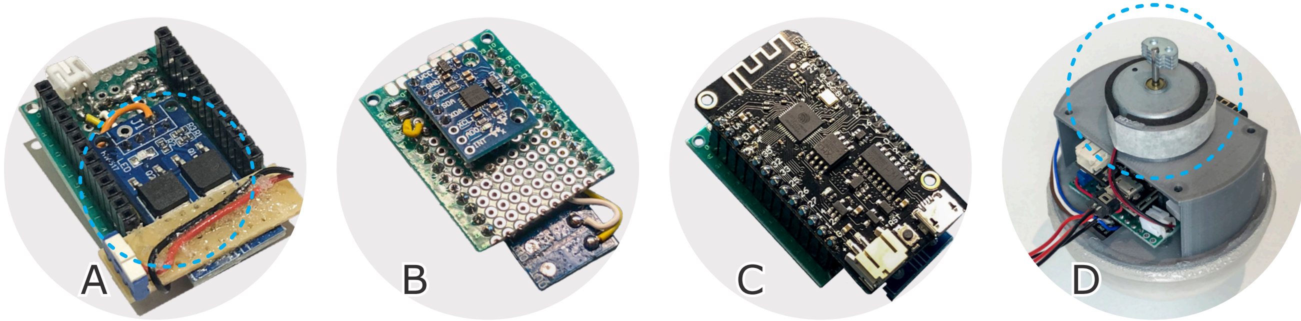

Figure 20. Exposed view of 2nd iteration; Double-side PCB is used to contain more chips (figure 20A, B); Dual-core ESP32 is used to placed single-core ESP8266 (Figure 20C)

3rd Iteration

In the prior prototype, while experimenting we found single-direction current did not allow us to achieve the motion we intended. Thus, a DRV8833 Driver Module, a H-Bridge that supports 4 channels of current, was deployed; Above that, we also explored different methods to enhance the wobbly motions, either by changing the interval of current, voltage, or the orientation of the motor; The center of the semi-sphere was melt to be slightly flat to avoid unwanted vibration

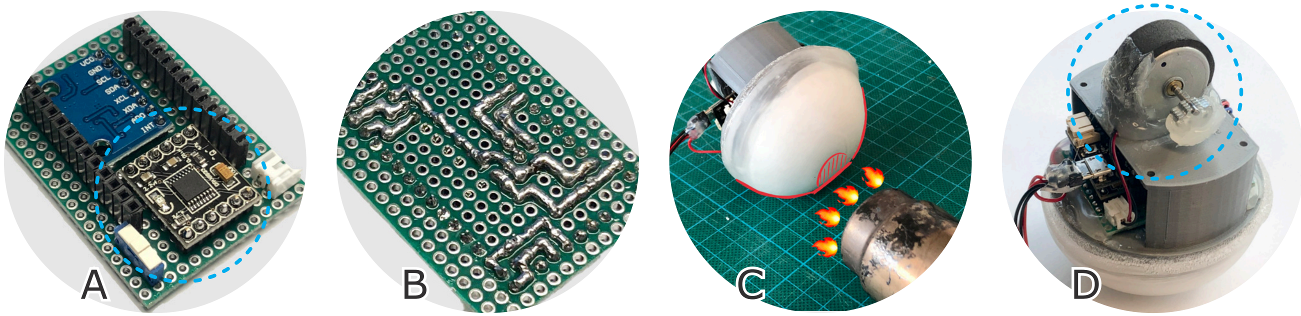

Figure 21. Fabricating process; DRV8833 Figure 21A, dual-channel motor driver is used to replaced Figure 20A; Using hot gun to create flat bottom Figure 21C; Using hot gun glue to add weight on motors

3) PneBall

PneBall: a volume-changing interface, aims to explore spatially related control, resembling Canvas[11], an interface that allows users to draw the area to which they expect the light setting (e.g. temperature, luminosity) applies (see figure 22); Combined together with Breath-in[33] , an elastic band that measures the volume changes of chest (as inputs) and inspired by the pneumatic container from [20,21] (as outputs), a haptic and shape-changing interface is ideated. It consists of three states (see figure 23):

1) when a user takes a deep breath, PneBall inflates;
2) when holding a breath, PneBall keeps its shape;
3) when exhaling, PneBall deflates;

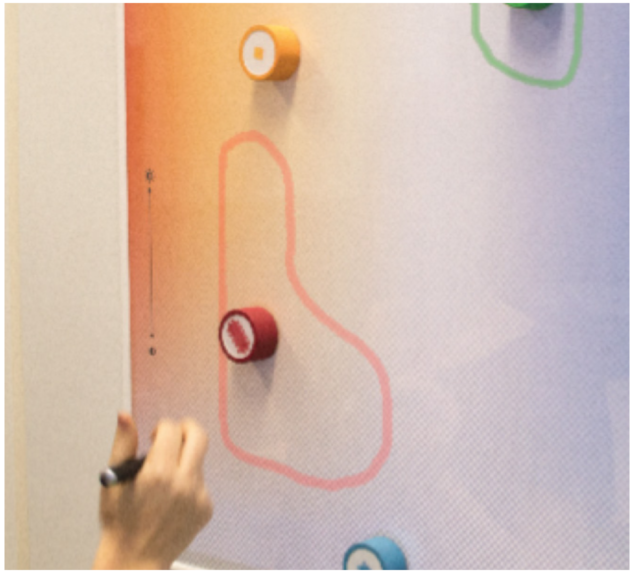

Figure 22. Preference Canvas

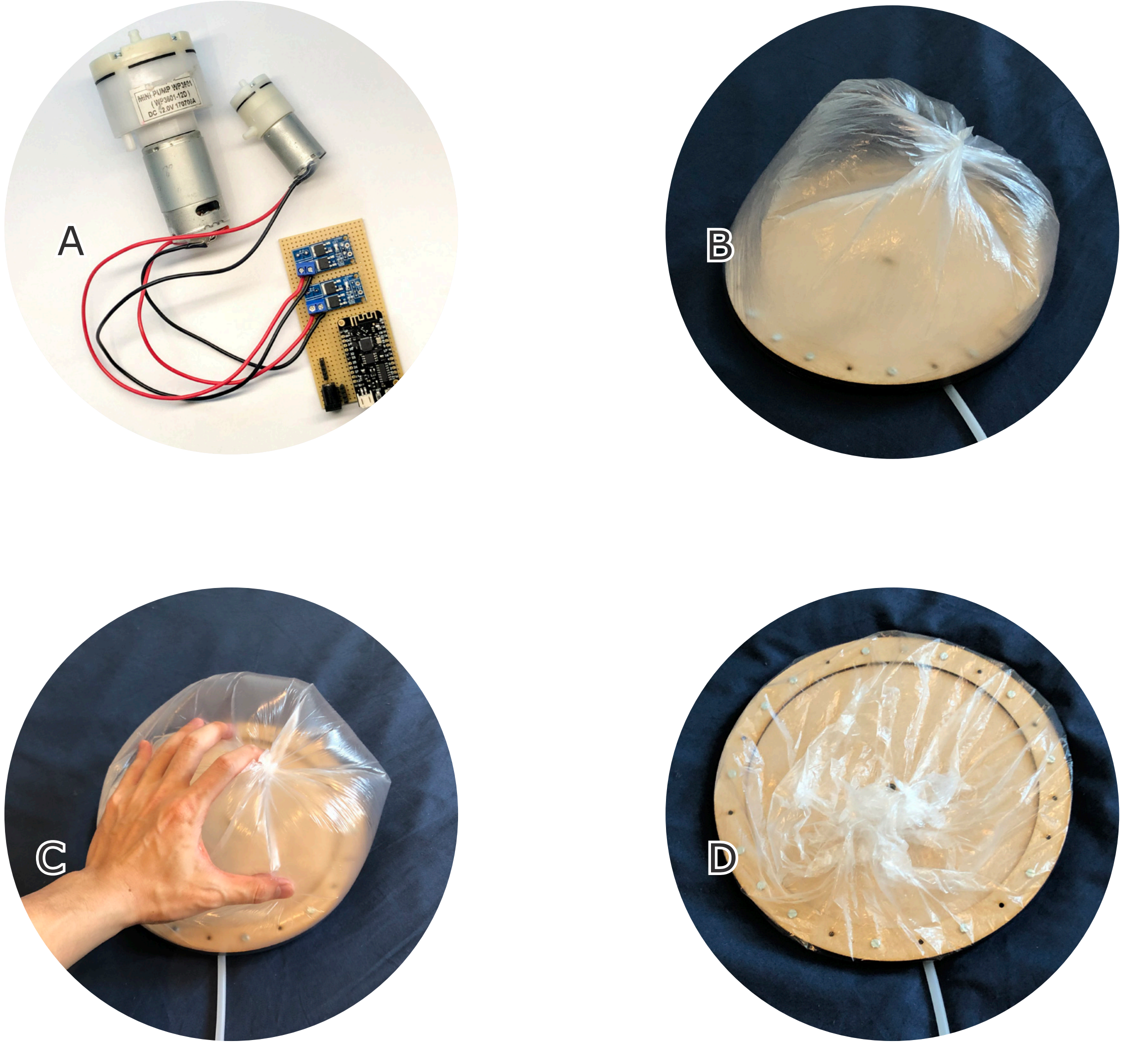

Figure 23. Working-in-Progress Demonstration of PneBall, pumping system amplified PWM with an ESP32. Figure 23A; three states [B-D] of PneBall

PRELIMINARY EVALUATION

In this project, the evaluation is mainly stressed from a technical perspective, calibrating the sensor and actuator to ensure fluent future user studies; Along the exploration phrase, Expert Reviews, consisting of three researchers (FMP mentor, Post-doc, PhD Candidate) were conducted periodically to objectively. From there, thoughts and concepts were discussed, resulting in the adjustments and elimination of infeasible ideations (e.g. a shape-changing lamp that expresses its intentionality with shape changes resembling Fonckle [14], designing seamless music listening experience on cross-platforms, etc). With the prototypes developed in this project, user studies will be conducted to evaluate how participants would perceive(/interpret/react to) the prototypes for the first encounter; To be inspired what functionality they might expect from how it reacts;

Figure 24. Demo Day Setup

TAKEAWAY FINDINGS

Addressing subtle output from tangible interfaces might be valuable. This project found few designs that leverage both subtle input and output tangibly on interfaces. People seem to have more interests in products that create motions. For designers it is necessary to address concepts in contexts as well as the inherent property of tangible forms.

Choosing appropriate components for suitable can save the day. Be mindful to whether the research tool is battery operated, low-latency required, high-current driven, data logging required, etc.

CONCLUSION

In this project, the design space for integrating tangible interfaces in Smart Homes was explored by means of extensively exploring design precedents and literature. This project synthesized both notions from the Tangible User Interface model and the Interaction-attention Continuum to gain ideas. Consequently, this project proposed and developed three interfaces addressing their subtle outputs, allowing systems to show their intentionality. The overall process and personal competence were articulated in this report followed by an appendix of reflections on learning.

REFLECTION

Techniques

This project has been heavily addressing hardware and software infracturing, resulting in most reflections on the techniques. Prior to this project, I have neither experience in managing multiple IoT devices, nor working with large current motors. Being exposed to state-of-the-art technology, such as serverless databases (Firebase, JSON-server using REST API), I am now able to serialize and parse JSON objects and arrays on IoT devices (ESP8266, ESP32). While the trying out with these toys, I also encountered some bugs on ESP8266/ESP32 SDK [38], Firebase-ESP8266 [35,36] as well as Firebase-ESP32 [37], which has also allowed me to make bonus contributions to the community; Unlike prior projects, shifting from wired project to IoT project can be a hassle. Fortunately, since the TU/e based server Data Foundry (developed by Mathias Funk) supports JSON realtime database with five times lower latency compared to Firebase, I correspondingly learned and developed snippet of codes to support that, which would ensure better stability of future prototypes;

Objectiveness

When an interaction design involves haptic experiences, the corresponding prototype has to function as expected because it can be challenging to mimic haptics without exposing the wizard. For instance, Topplr has to tumble down itself in proper contexts during the evaluation. Asking participants to imagine does not seem to be objective and convincing. However, as a researcher I should have tolerated the imperfection of the haptic quality. A half-working prototype might already be able to abstract some insights for early adjustments. Although I did present the half-working prototype to the visitors (at least 15 students) on Demo Day and received remarks for the designs (many are technical suggestions and enquiries), the setup could have been improved. I could have asked them to share how they feel and imagine/ co-design what they expect from the behavior of prototypes. Meanwhile, this project assumes all prototypes are context-aware but few investigations of literature about that are conducted. In the future work, related work and theoretical background about context-aware should be included.

Writing

Writing and documenting have always been my distinct shortcoming. I usually need a partner to work along or a sample to suggest to me what should be included as I usually would think it is too trivial to articulate all tiny details. From the remarks of this retake, I learned that it is essential to demonstrate either what achievements I have made or the contribution of my work. As when reviewing others publishcations, we always want to abstract valuable information as fast as possible. So while documenting, it is necessary to maximize the value and clarity of figures and texts.

Time Management

At the early stage of the project, I have been struggling in defining and redefining the design direction for my FMP, which makes it hard to schedule a one-year plan when no concrete direction is defined. Keeping I was kind of being idealistic on time as I thought I could develop three functional prototypes simultaneously and evaluate them later one. However, it may be not no timewise. This might be better to follow an asynchronous prototyping schedule (conducting user evaluation right after a prototype is done) as I might learn from the evaluation prototype.

In parallel with this project, my schedule has also been divided into other tasks not necessarily related to this project but is highly related to my future development. Beside the project, I have also completed my pictorial submission to 2020 ACM Designing Interactive System and my 2nd Master's program application, which therefore requires me to deploy my portfolio correspondingly. During the deployment, I also encountered the DDoS (Distributed Denial-of-Service) attacks, which forced me to add hourly local snapshot, daily backup to Google Drive and DDoS protection by CloudFlare; To accelerate visiting speed globally, static resources are hosted on OSS (Object Storage Service) in mainland China by Aliyun and CDN (Content Distribution Network) is incorporated for overseas visitors; As some peer students were enquiring the setup process, a portfolio setup guide is being documented.

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LINKS

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