CoDiet in IoT Home System:
Eating Communication and Scheduled Calendar for Multiple Users

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Abstract
CoDiet, an interactive product, is developed with the framework of rich interaction with a growing systems approach. The reports are divided into three main parts to introduce the development and the theories applied in the iterative process, including (1) Iterations of the Interactive IoT Design: CoDiet (2) Designing for Rich Interaction in Growing IoT : CoDiet with the Theories of Interaction (3) discussion, conclusion, and future work.

Author Keywords
Home IoT; Growing System Approach; Rich interaction; Tangible interaction; Affordance

Introduction
Due to rapidly growing advanced technology, the Internet of Thing (IoT) opens enormous opportunities for innovative appliances to enhance human's quality of life (Lin et nl., 2016). The term, IoT, has been described by multiple authors in various ways. One of the most popular definitions defines that IoT is an interaction between the digital and physical world (Vermesan et al., 2011). Sethi and Sarangi (2017) proposed that IoT refers to a whole new world where a network connects with all the appliances and devices

we used. As different sensors in digital devices collect data from human's daily life activities ranging from self, home environment, and public environment, the devices have developed an IoT system.

However, the IoT products displayed in the shops or home environment were with the striking features, such as digital displays connected with the smartphone applications, i.e., Fitbit (Fitbit, 2017). In the course of A designerly perspective on IoT: a growing systems approach instruced by professor Joep Frens, the explorations of adopting the design concepts and design processes among the embodied interaction (Dourish, 2004), tangible interaction (Ishii and Ullmer, 1997) and rich interaction (Frens, 2006) are mentioned, practiced, and further developed the ideas in order to look for a new opportunity to let the current IoT system being able to change and grow.

The structure for introducing the design journey of CoDiet is intertwined and formed through the iterative process of assignments as well as the framework of rich interaction proposed by Frens (2006). The framework of exploration for a rich interaction, presenting how an interactive product can support human skills through offering embodied interaction, states a new paradigm to construct the aesthetic and function perspective of the product. CoDiet, which consists of the ball controller for individual users and the devices to reflect the data integration through the aesthetic patterns on the devices, is an interactive product for promoting the communication between multiple households. The design has been developed through 3 iterations to develop the first design idea with a low-fidelity of interactive prototype. After a feedback session for improving the rich and embodied interaction of CoDiet, we have processed 2 iterations to come to the final digital prototype, including both core functionalities of eating communication and scheduled calendar and the emergent functionalities of the changing patterns on the base part of the device.

The report will be presented with the clear explanations of the process to develop CoDiet. Furthermore, the concepts of affordance (Gibson, 1986), information-for-use (Wensveen et al., 2004), embodied interaction(Dourish, 2004), tangible interaction(Ishii and Ullmer, 1997), and rich interaction (Frens, 2006) are twisted within the design journey. In the last paragraph, the process of usage and the details of the interaction will also be explained explicitly.

Iterations of the Interactive IoT Design: CoDiet

Introduction of CoDiet: Eating Communication and Scheduled Calendar

Introduction of CoDiet

CoDiet has been designed to offer more possibilities for users to communicate with their households, including the family members or the flat mates. There are several user scenarios which provide the user can not only set up their personal setting individually, but also see the integrated results of the calendar and eating preference from the other members. The following paragraph will be described through the structure of discussing the design journey to explore the form, the interaction, and the function of CoDiet. The decisions, which have been made through the design journey, will also be introduced in the later paragraphs.

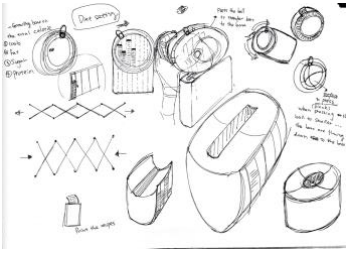

Figure 1. Ball shape to transform the data as liquid flowing to the base device.

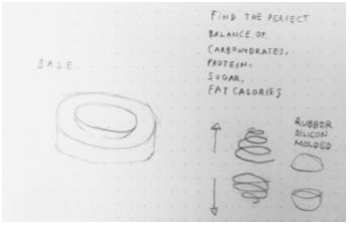

Figure 2. Ball device with springs to change the form

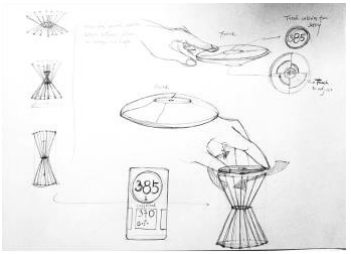

Figure 3. Individual panel with the elastic changing form on the base.

Eating communic ation as the first core functionality: The process and result of Assignment 2b

"In Assignment2, the rich and embodied interaction style should be shown on the IoT device design of locus of interaction' for home IoT."

In Assignment 2b, a topic (functionality) of Communication from the home scenario was chosen, which was meant to start from a design exercise of a Rich Interaction "Locus of Interaction" of the IoT device. During the ideation session, several topics related to communication have been proposed and discussed. Emotion and delivery were chosen to be developed through the discussion. However, either of them cannot trigger the common interest among the group. Therefore, for the next discussion session, we have focused more on a "home" scenario to reconsider all the potential topics among the communication in a home context. "Eating" including the ingredients, the eating process and all the related topics have been considered. Thus, one of the main issues among eating, which is diet, i.e., fat, fiber, protein, and protein, becomes the most interesting topics for the group members. This topic is very popular in the young generation, who care about how to eat smart and healthy.

Exploring relations of the form, the interaction, and the function of CoDiet – Phase 1

Among the 2 iterations, the forms of presenting the changes of the amount of calories have been discussed. The sketches were the forms discussed in the first stage. The sketches on the left column of figure 1, 2 and 3 have been discussed in the group. The concepts of ball form and the patterns as metaphor of data transformation were chosen for developing the further prototypes of the form exploration.

The action and reaction between human and product for "feeling" the interaction are considered in this device. The operational process can be divided into 4 processes which are shown from figure 4 to figure 7.

Figure 4 (left). Process (1) Turn and adjust the middle disc for choosing the category of the diets, i.e., fat, fiber, or carbs.
Figure 5 (right). Process (2) Rotate the side bar to put in the diet data. Size of the ball is changed corresponding to the input and output amount of the diet data. For instance, when the user sets the diet for 50 calories of the fat, 150 calories for the fiber, the ball will swollen from the back due to the growing amount of the diet.

Figure 6 (left). Process (3) Put the ball into the main device after the individual diet setting.
Figure 7 (right). process (4) Press the ball into the base for

transforming the input of diet data. The growing feature of the patterns is showing while the data is transforming.

In this phase, the device was focused on developing a rich and embodied interaction style connected to the nature of CoDiet. In the assignment, we have considered an alternative reality for replacing smartphones, tablets and computers as the primary input and output devices of IoT systems. However, even though we have tried to incorporate the physicality and expressiveness of the design to make it meaningful, the functionality of the device is missing. How can the users communicate with other people about their diet preference through this device? What is the function of the base? How can we improve the patterns shown on the base more meaningfully? And could the sliders of each parameter of the diet have been improved to be more interactive, meaningful and rich? More details should be presented and further iterated to reach the goal of rich interaction after the assignment 2.

Calendar as the second core functionality : incorporated into eating communication

"In Assignment 3b, the group has chosen a new home functionality to add to the design of Assignment 2b. In this phase, we have to polish the design in the "distributed vs. centralized" dichotomy and consider four 'approaches to growth' in the literature (Frens, 2018). "

In order to keep the good parts from Assignment 2b, we have kept the round shape to represent the aesthetic of this interactive product. In addition, we started to combine more interactions for fulfilling the Calendar functionality. The added form were shown in Figure 8.

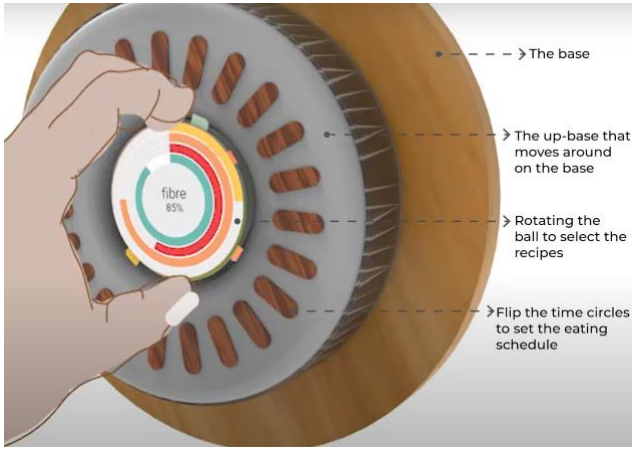

Figure 8. CoDiet: the first digital prototype of the two functionalities.
(1) the round pattern, which is formulated through several oval clips on the schedule base; (2) various colorful adjusting bars for altering the diet parameters on the ball; (3) the surrounded ring of the schedule base; (4) the movable schedule base on the panel to show the change of the diet parameters.

Suggestions to improve from the discussion of Assignment 3b

" The improvement of rich and embodied interaction on the devices, including wooden handle interaction, the function and the patterns of the base should be more meaningful; and a meaningful design should be further iterated, like the communication part of the whole design."

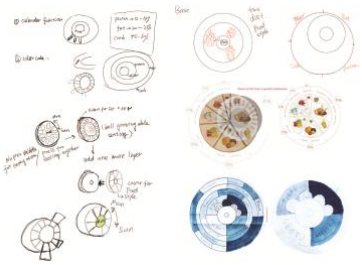

Figure 9. The sketches during the iterations of the ball interaction, the pattern changes on the base, as well as presenting the meaningful information on the whole design.

Figure 10. The iterations for the forms and shapes of the ball, bases, and the patterns.

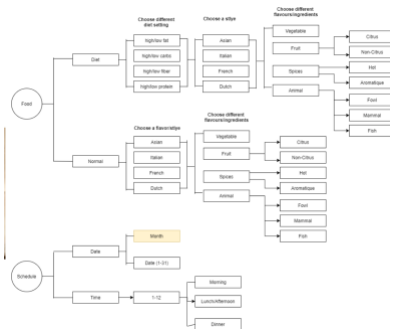

Figure 11. The diagram to show the core functionalities of the calendar and the eating settings.

After receiving the feedback from the lecturer, we found it is nice that CoDiet could provide social support instead of the mediating role. The things could be improved were that (1) The wooden handle interaction on the ball would be better if each nutrition option (such as fiber, fat etc) could have corresponded with one handle. (2) The communication part of the whole design is unclear. We were suggested to combine the individual goals on the token with all the other members to create the recipe together. (3) The base should be more meaningful due to the unclear purpose for the current design. Therefore, we have focused on these suggestions to incorporate the guideline of assignment 3 to create a "systems design".

Rich Interaction and Growing System with Two Core Functionalities and Emergent Functionality

"Let the interface 'grow' to incorporate the functionality, especially also focusing on emergent phenomena."

Exploring the form, the interaction, and the function of CoDiet - Phase 2

Several iterations happened after confirming the functions of two main functionalities. The further discussion with the form, the function and the interaction of the ball has been gone through many discussions, which are shown in the left column with Figures 9 to 11. One of the major difficulties is the complexity of the information shown from the functionality of the calendar and the eating communication. Questions such as how should these information be represented to show everyone's eating preference and how should information changes and reacts after more inputted data from different people, should them be presented integrally or separately? In order to answer the above questions, we tried different approaches of the rich interaction. Furthermore, meaningful designs including each diet parameters, the meanings for the pattern changes from the form perspective; the aspects of the function in CoDiet; and the most intuitive way to control, monitor, and interact of every action possibilities, were discussed thoroughly.

Emergent functionality with the growing patterns

Among the iterations and the development of the rich interaction, two core functionalities of the CoDiet are designed, including eating communication and scheduled calendar. The feature of openness brings a "growing dynamic" in the IoT system. Since the functionality in IoT home systems is constantly changed due to the add or remove of the artifacts, the functionality in the IoT system is not stable. Interestingly, the involvement of the multiple users in an IoT system brings the unpredictable emergent of the functions. Therefore, the emergent functionality has become a challenging design and brought the fascinating features for the design process (Frens, 2017).

Core functionalities presented on the ball controller

In CoDiet, the ball controller plays the roles as the core functionalities for both eating communication and calendar. Moreover, the emergent functionalities can be referred to the schedule base, diet ring, and bottom disk for flavor and ingredients pattern. The three elements on the bases as emergent functionalities have brought more rich and interactive surprise for the multiple users involved in the IoT home system. A using scenario is shown in Figure 12. The details of how

the tangible and intangible interaction are formulated by the embodied interaction through the information-for-use will be described in the following paragraph.

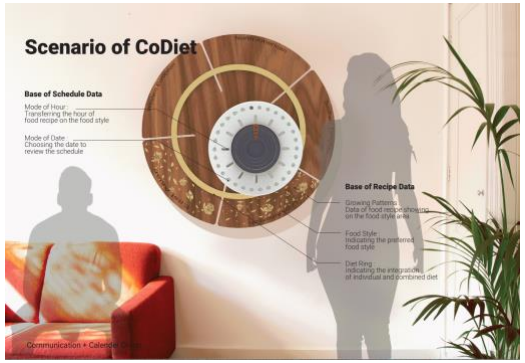

Figure 12. Scenario of CoDiet

The interactive process of CoDiet involving multiple users

The main steps and the major operating process of the usages are visualized in the Figure 10 below.

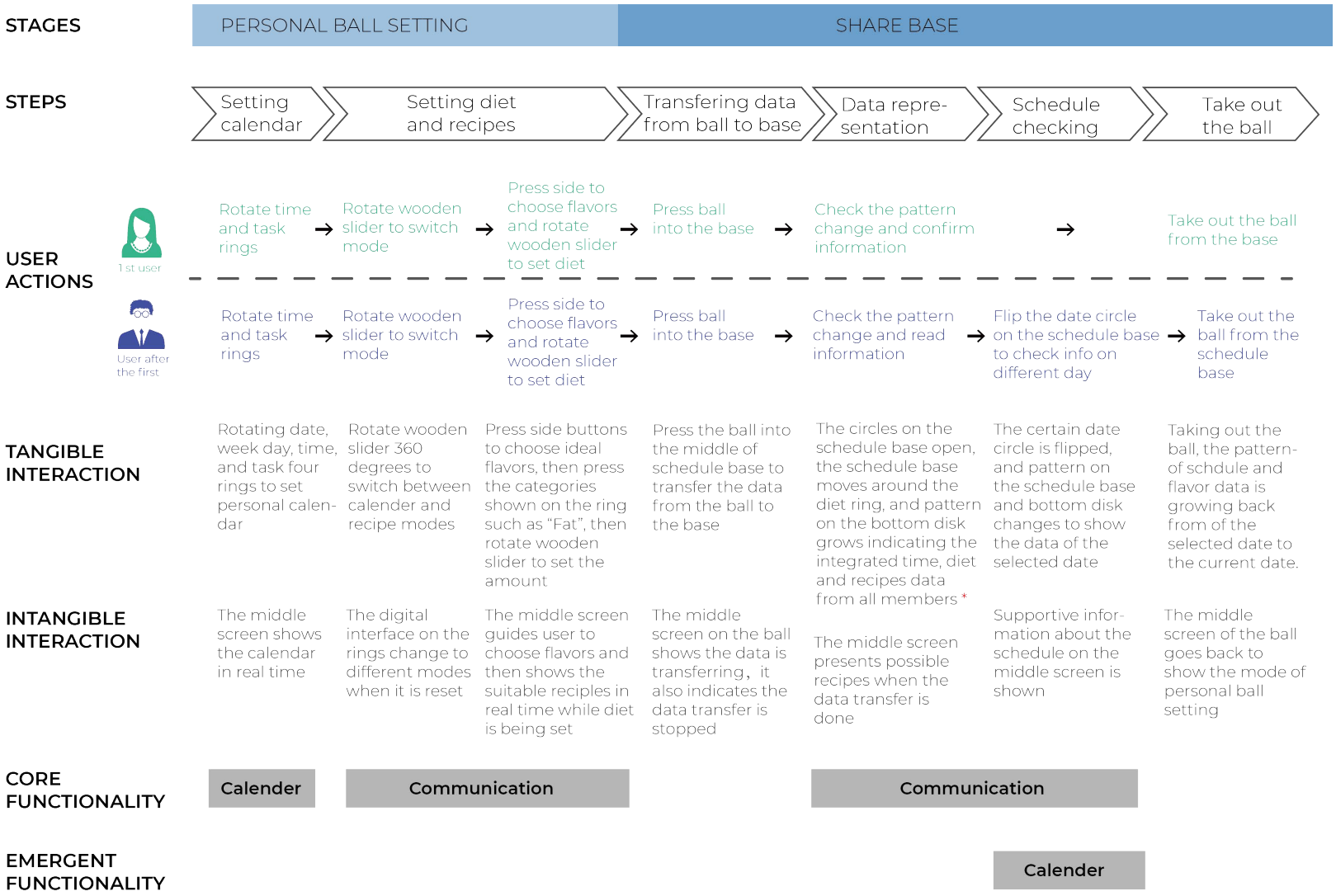

Figure 13. Interaction process of CoDiet for the multiple users

* *The detailed information about how the pattern changes is explained specifically in the base interaction part*

Designing for Rich Interaction in Growing IoT : CoDiet with the Theories of Interaction

"Several interaction concepts, including Affordance, Tangible Interaction, and Rich Interaction with Embodied Design, which resulting the final version of CoDiet have been discussed, explained and incorporated into the its form, function, and interaction."

Affordance and Tangible interaction

Affordances in the design

The theory of affordance offers insight of realizing embodied interaction, information-for-use required to refer to human skills (Frens, 2006). The affordances could be explained as what the environment affords people. The affordance here is the relationship between the environment and human beings (Michaels and Carello, 1981). There are many evidences in our design about applying affordances that lead users to understand the ways of interaction. For example, the holes on the wooden slider give an intuition to users to press them. Another example, the middle hole on the schedule base with the same size of the personal ball guides users putting the ball into the base. Besides, many sizes of the design have been considered to offer better affordances to users, such as the size of the ball is perfectly for holding on the hands.

Tangible and intangible interaction

Tangible user interfaces represent the integration of tangible input and output, rather than digital information. The interactions triggered through tangible interface, i.e., physical objects (Ishii and Ullmer, 1997), are action driven rather than cognition driven (Frens, 2006). In order to enrich human experience on using products, Overbeeke et al. (1999) had argued that three types of human skills, including cognitive, emotional and perceptual-motor skills should be considered. Dourish had further referred to the tangible interaction as a next step to incorporate more human skills and abilities into the interaction with computers (Dourish, 2004, p. 14 and p. 126). Therefore, embodied interaction has been proposed that humans can interact with the world through doing instead of knowing (Frens, 2006, p.37). Dourish (2004) defines that embodied interaction as: 'the creation, manipulation, and sharing of meaning through engaged interaction with artifacts' (Dourish, 2004, p,126). Thus, tangible interaction provides opportunities for interaction to be embodied by a wider range of human skills (Frens, 2006). The importance of developing tangible interaction with embodied features provides an insight for the current designer to design products with the action-driven mindset. CoDiet has been started to develop on this basis.

Ball interaction: core functionalities, including diet mode and calendar mode

The personal ball is consisted of the tangiable parts of 4 rings (mixed with the digital screens on each rings), 1 wooden slider, 4 holes on the wooden slider as well as the intangiable parts of the middle screen.

The form, function, and interaction of the individual ball

The individula ball contained the data of calendar and eating process. It represents the role as a token in the rich interaction design. The token (the ball) resembles the data in a phisical way. Thus, the ball can be

deemed as a metaphor, which fusing the information from the calendar and eating process, i.e., food selection (Fishkin,2004；Holmquist et al., 1999). Thus, the personal balls are designed to collect, contain, and transfer data. There are two different modes on the ball which are diet mode and calendar mode as two main functionalities, including eating communication and scheduled calendar. As the usage is designed, every family member has their own individual ball to schedule on the calendar and eating preference.

The operation process of the calendar mode: form, function, and interaction

In the calendar mode, four rings on the ball from inner circle to outer circle indicate Tasks, Time of day, Day of week, Date respectively. The four rings can be rotated 360 degrees with the information on them displayed digitally. And the wooden slider as a monitor bar, which is always steady at the position of twelve o'clock. When users want to plan a calendar, they need to rotate the rings one by one to and let the scheduled time (for instance, 01 indicates the first date of the month) be shown in the circles of the wooden bar. Then, the user has to press the screen of the ring through the circle on the wooden bar to confirm the chosen time. For example, the user wants to plan a calendar that " On the 1st of April , Monday, At 18:00 to have dinner with family", the user can rotate rings to the state as the Figure 14 shown.The wooden slider with the holes and the round shape of the ball guides the users naturally interact with these forms. It shows the affordance of the ball and the wooden bar on its design.

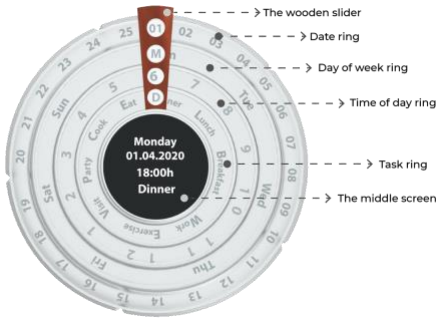

Figure14. The personal ball on the calendar mode with a specific setting.

The operation process of the diet mode: form, function, and interaction

The other mode of the ball is the diet mode for setting the eating preference. The means of the tangible interaction are changed by using the same elements on the ball in different ways. The four rings on the ball from inner circle to outer circle represent Protein, Fiber, Carb, Fat respectively. There are push-in buttons on the side of the ball for the flavor setting. The flavors are selected depending on the results of the scientific report of flavor network (Yong-Yeol, 2011), composed by Southern European, Latin American, East Asian, North American, Western European. Please see the Figure 15 for clear details. Here, we made the patterns meaningful.

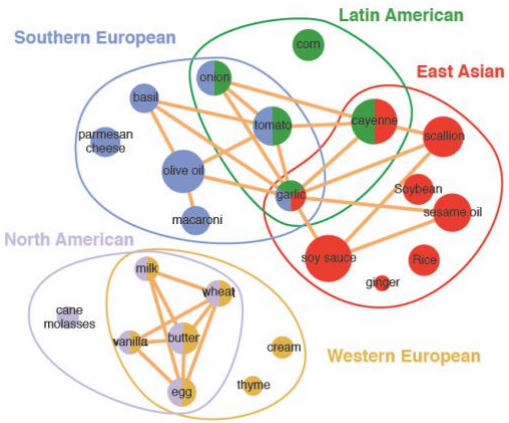

Figure15. Flavor map and with main ingredients (Yong-Yeol, 2011)

The clear using scenario is introduced below. Firstly, the user needs to choose their interested flavors by pressing the push-in buttons on the sidewall of the ball. If the users want to plan the eating schedule and preference ahead, in the diet mode, he/she can set multiple days at once. For instance, he/she can set the eating schedule and preference for the whole week on weekends.

After selecting the flavors, the user can further set the diet preference. Firstly, he/she has to press a certain category (The category is presented in the holes shown on the wooden slider). Then, he/ she should turn the wooden slider clockwise to set its amount. For instance, the user wants to set the diet of fiber and protein for today. He presses into the how shown F (Fiber) on the wooden slider, then he is able to rotate the wooden slider to the amount of fiber he wants. The bigger degree he turns the wooden slider, the higher amount he sets for the fiber. When he confirms the setting of the category, he needs to press the F hole again for confirming.

After confirming, the wooden bar goes back to the original position automatically. The input diet data is saved in the system in the meanwhile. While he is setting the other categories, the middle screen shows the matched and recommended recipes in real time mode. The matched recipes are recommended depending on the input diet data and chosen flavors. After he finishes the setting, the interface is shown as the Figure 16. The recommended recipes shown on the middle screen of the ball, which is able to be scrolled for viewing more options. The users can choose their preferred recipes by pressing the middle screen.

The interaction of changing between two modes
For switching between calendar and diet modes, the wooden slider has to be turned a full round.

Digital interface of the ball
The middle screen on the ball is the intangible interaction of the ball. It provides an intangible interaction between the user and the device. It is used for information display and the guidance of physical interaction. In the calendar mode, the middle screen shows the calendar information of the current setting and changing in real time while the ball is set. In the diet mode, firstly the middle screen shows the flavor area and guilds users pressing the corresponding position on the side of the ball. While users are setting diet categories, the middle screen displays the matched recipes in real time. And diet setting is done, the possible recipes are scrolling on the middle screen.

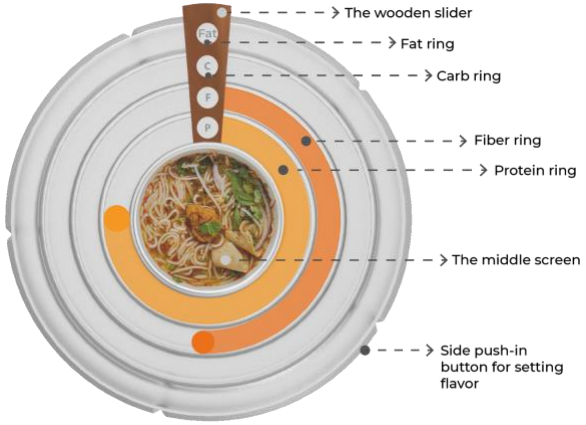

Figure 16. The personal ball on the diet mode with a specific setting

Base interaction : emergent functionalities, flavor patterns, diet relocation, and calendar patterns

Wensveen et al. (2004) develops the frameworks of feedforward and feedback. The feedforward provides the information of what can the user do with a product and what will happen after the user acts (i.e., the affordance); the feedback here can communicate the information with users. The concept of the base is offering feedback to users and realizes the communication between the users and the objects. In the means of shape changing and pattern changing after the data transferring, it offers the unpredictable and the rich information as feedback to the users.

The form, function, and interaction of the base
The base as a sharing part in this design is used for physicalizing the data and displaying them as a decorative object at home. The patterns on the base not only physicalizes the transferring process of the data stream from the personal ball to the sharing base, but also visualizes the final and integrated results from multiple users. The entire base comprises three main parts which are the schedule base, the diet ring and the bottom disk. The explosive view is shown in Figure 17 below.

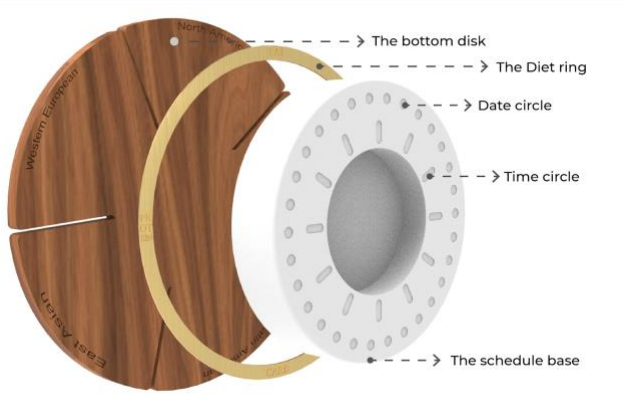

Figure 17. The explorative view of the base

The relation of forms, function and interaction of schedule base
The top part of the base is the schedule base that presents the results of date and time. The outer circles with 31 round shapes, represents the date of the month. The inner ring formulated with 12 oval circles, indicates the integrated available time period for having meals together from all household members.

The relation of forms, function and interaction of diet ring
The schedule base can move around the diet ring and stops at a certain position where it indicates integrated diet data of all members. For example, if the schedule

base stops at the top right of the diet ring that means the integrated diet could be a relevant type of high fat and high fiber. The movement of the schedule base won't cross the diet ring, the end position is more far from the center and more close to a certain direction where the diet categories locate that explains the diet type will have a higher amount of the certain category.

The relation of forms, function and interaction of bottom disk
The third part of the base is called the bottom disk which is divided into five parts indicating five areas of the various flavors. The pattern will grow and change according to the input of the recipes, i.e., ingredient. The patterns are consisted of the leaves. The leaves will gather together and form around certain ingredients (shown by text) on the selected area of flavors . The automatic changes are according to the data of food recipes which were selected on the personal ball. As shown in the Figure 18, patterns are shown in areas of flovours, like the Latin American and East Asian areas. The leaves are presented with different densities on some areas of ingredients. The high density pattern appears around the text of soybean, ginger, onion, and tomato, which means there are high percentages of the mentioned ingredients from the current recipes. Patterns keep changing while more data is put and integrated from the multiple users.

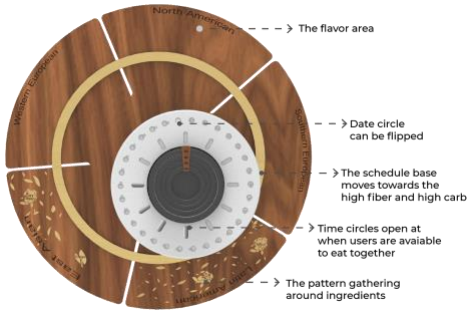

Figure18. Pattern of the base

The relations between the individual ball and the bases
When a personal ball is pressed into the hole at the middle of the schedule base, the patterns start changing and growing on both the schedule base and the bottom disk. The changes of the patterns are on a daily base. If there is only a person put the data for today, the patterns will merely show the result of the user on the bases. Moreover, if there are the second person puts in the ball and transforms the input data, the patterns shown on the schedule base, diet ring and the bottom disk will be the integrated results from both of the users. The same process for more users.

In addition, people are able to review the input information for the date in the past or in the future. As long as the data has been transferred into the base before, they can browse the setting of preferred meals, tasks, or the eating time with other household members. By flipping the circle, representing a date on the schedule base, the patterns on the entire base will show the result of the chosen day. Once a user takes out the ball from the base, the patterns stay or change back to the integrated result of the current day.

Rich interaction of CoDiet: a growing systems approach of home IoT

Following the diagram of rich interaction proposed by Frens (2006), CoDiet becomes an designerly experiment, which is an interactive product and used in a home IoT growing context. In this example, we apply a growing systems approach with hybrid, service and shape changing approaches among CoDiet (Frens, 2017).

Hybrid Approach
CoDiet is comprised of the screen based interaction to deal with the rich actions, including the ball is an individual controller, which is able to adjust the parameters with tangible sliders and the intangible screens for the interactions, i.e., press, scroll, and touch. The balance between coupling between the

physical action possibilities and what can be shown on the screens have been considered and discussed carefully. Finally, we have chosen to apply digital screens on the rings, which show the complex parameters between eating communication and the calendar. Moreover, the diversity of the recommended recipes are also considered as the part, which is appropriately shown through the digital display. What we don't want to miss and consider as an important tangible material here are the movable rings and the wooden slider on the balls. Therefore, the function of the ball can not only provide the rich interaction on these parts, but also provide an emergent functionality on the screens of the rings. The preferences, habits, or the favors from different types of users could be shown here.

Service Approach
CoDiet has also been applied with service approach in the growing systems approach. It is able to create 'hyper-personalization' of embodied and rich interfaces, which has been shown clearly on the digital ring-screen, and the patterns shown on the bottom disk. The remarkable features on the ball are: the changeable parameters of the task ring and the recommended recipes. The tasks shown on the rings are chosen from the most regular or planned schedule from the personal records on the calendar. Furthermore, the recommended recipes are fully customized with the favored flavors and the preferred diet styles of the meals. Besides, the bases have indicates the integrated information to provide an overview with the integrated schedule and time for eating as well as the details of the ingredient from the integrated recipes.

Module Approach
CoDiet is applied Module approach in an indirect way. When the CoDiet system growths, it is added the calendar function. The design of the personal ball was adjusted to have two different modes. Even it is happen on one ball, the way of tangible interactions of two modes are totally different. These two modes are connected with each other and shared the middle screen together. In this case, the middle screen is the media centre which allows the new mode joining. Therefore, we considered it is still a modular approach to grow the system.

Shape Changing Approach
In addition to the hybrid and service approaches, the shape changing approach is also applied to CoDiet. The shape of the ball, the movable schedule base aligned with the diet ring, and the shape of the patterns have shape changes according to the input data. Interestingly, the shape changing on the ball gives a physical feedback by presenting the swallowing or reduction size of the ball. The shape changing of the patterns on the bottom disk and the changing position of the schedule base, provide the users the opportunities to view the data from the other users and promote the chance for communicating through the device or in the other time and space. The shape changes on ball, movable schedule base, and the patterns are depending under computational control. This is how the interactive node reflect rich actions in the response to "growth" of the systems.

Conclusion of the growing systems approach
With developing CoDiet through all the interactive theories, framework, and approaches, CoDiet becomes the interactive design with rich and embodied interaction. It provides the aesthetical interaction for realizing the nature actions of human skills, and offered the an open space for exploring the unpredictable, ever-changing emergent functionality by adopting growing systems approaches.

Discussion and Conclusion

Within the goal and the main interests in the lecture, CoDiet has been developed through many iterations following the instruction of the framework of the rich

interaction. The devices are able to be explained and gain the benefits from applying the concepts of embodied interaction, tangible interaction, and rich interaction. Considering the core value of this practice, the importance of acknowledging the vital elements between humans and the objects and the meaningful changes through the form and aesthetic, an interactive product has been designed to lead the user to follow the most natural movements of the body. There are several things that could be discussed under this topic, including the importance of the home scenario and the feedforward as well as the feedback information given among the design.

First of all, considering the information-for-use, the design of wooden bars in CoDiet could have been discussed. We have considered if every parameter has one control bar would be a better choice for rich interaction, which may be able to provide natural information-for-use. However, since the two main functionalities, including eating communication and scheduled calendar, have very different indications, providing the control bars for each of the parameters, i.e. date, hour, task, fat, fiber, could be more confusing. However, believing in the theory of rich interaction, the interaction on the wooden control bar could have been improved.

Secondly, the topic of home context has given a good scope of including various IoT devices with multiple users. In the beginning of deciding the topic, delivery communication, like DHL, has been discussed. After the proposal, there is a discussion on if this is in a home context. This could be deemed as an emergent phenomenon for the extension in the technology. More technological devices are invented and used out of the tangible house, for instance, the drone. What if the drone can deliver the shopping stuff one day? What if the drone becomes a little fairy to light up for the users wherever they want? This example may be exaggerated. However, it is a truth that the interactive model of humans and the products could be changed to anything nowadays. Importantly, the foundation of starting from the needs of humanity, such as the theory of affordance and the information-for-use, could still be the pillars for supporting the interaction being presented in any formation.

In a nutshell, the iterations of the CoDiet have brought us through a vital lesson to learn from the concepts formulated to the rich interaction, which could be used and evolved further in the future design of IoT systems.

Future Work

In addition to the current presence of CoDiet, there are several ideas that have been discussed during the assignment. The group agrees that these are the valuable design elements to be considered in the future work.

Firstly, core functionality of the calendar could be developed with richer interaction. Besides setting time and tasks, other main functionalities of a digital calendar such as sending invitation and notification, could be added as core functions.

Secondly, Core functionality of the communication is limited in the context of diet setting. However, in order to enrich the interaction on communication, the step of how to decide recipes among all family members is important to be incorporated in the end of the interaction process.

Although we design the function of diet setting with referencing a few diet meal applications and the scientific information of diet type, there is still a lack of contextual information from users. Some complex contextualized realities about how family members plan meals together and how to have a diet while eating

together with other house members need to be drawn in the interactive design of diet communication. Therefore, the process of setting the eating preference with diet requirements could be re-considered to suit the using habits of most users.

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Individual Reflection from Chia-Hsiu Liu

DCM110 A Designerly Perspective on IoT; a Growing Systems Approach

The purposes of taking this course are from my curiosity of asking why a designer is a designer? How human-computer interaction becomes one of the main trend in design disciplinary? What are the values to be a designer in this rapid changing and digital world? In the end of the lecture, I am not only inspired to answer the aforementioned questions, but also closer to realize the areas of expertise in my PDP, including Creativity and Aesthesis, Technology and Realization as well as User and Society. The lecture provides a clear insight of the elements which can leads us to explore step by step for the interesting, rich and meaningful aspects of a growing systems approach. The learning progress with a designer eye will be introduced gradually below.

From the 1st assignment, there is the opportunity to understand the theory of affordance from theory of ecological perception (Gibson, 1986) and tangible interaction (Ishii and Ullmer, 1997), which provided me a perspective to think the relations between the actions acted among the form of the objects, human body and the environment. It was a moment that I found a design could be so closed to the needs of our body shape, and is designed to become meaningful parts of our surroundings in a theoretical explanation. Furthermore, the discussion of the current designs existence of affordance was discussed in the lecture, which led me to have deeper thoughts of combing the psychological theories and design. The most inspired interaction in our documentation was people like to squeeze the cigarette butt in any kinds of small cracks and anywhere. From the perspective of a designer, this reminds me of thinking: how should a designer designs things with the proper shapes, which can invite actions from the users naturally and intuitively? The lesson gave a fundamental concept to move on for further discussion of designing the interaction.

From the 2nd and 3rd Assignment, the literatures and design practices again have brought me gone through the concepts and the design process by applying embodied interaction (Dourish, 2004), tangible interaction (Ishii and Ullmer, 1997) and rich interaction (Frens, 2006) in a growing system (Frens, 2017). It was the comfortable moment to realize and understand the mentioned theories. Still, there are two main challenges for me among the whole process. First of all, when I had read the papers piece by piece, and tried to deploy them in the Assignment2, here comes my 1st learning part. In this phase, the form, function, and the interaction of the objects were still been thought separately. Even though the shape and patterns were design aesthetically, there were things missing for constructing a "rich" interactive and the "meaningful" feedback. Secondly, moved to Assignment3, a growing systems approach should have been incorporated into the design. The multiple users were included. However, the beauty and surprise from the emergent functionality was still not clear here. It was difficult for me at the beginning to apply the theory and transform perfectly into the design.

With more inputs from the prototypes, the literatures, the discussions in the lecture and the group, we picked up the scattered parts to complete this puzzle. We have considered every elements of the forms and shapes, the reasons of being rich and interactive interaction behind the shape, and gone through the arguments of

how can we reduce the cognitive burden if we still want to use the color, text or icon to represent any meaning. From the process, I have experienced the benefits of the "just-do-it" and "hands-on" attitude in the design process. By doing, the thoughts can be presented even further progressed with what in the mind. Also, try to move on with the knowledge in hands even with the questions.

I am definitely glad that I got to know about the Growing Systems Approach with rich interaction. It not only gives me another perspective to understand human-product interaction. Importantly, it gives a treasurable value for designers. I will bring this deep knowledge to go on my designer journey and apply it in a wider range of the topics.

Individual Reflection from Jing Li

DCM110 A Designerly Perspective on IoT; a Growing Systems Approach

Through the course of Designerly Perspective on IoT, I gained the knowledge of designing rich interactions within IoT systems from a different perspective. Human product interaction has been a trend for industrial design for many years, there are many interpretations about what are good approaches to realize the interaction on products. With the development of IoT systems recently, many challenges appear. One of the challenges is that an IoT system faces is complex contextualized realities in a certain context. How to design interaction to help users understand the usage intuitively and offer users a better using experience are important to consider for designers to overcome challenges.

Also, the IoT systems are growing systems changing at the same time, meaning every part of the system should have the capability to be open to connect to each other as the emergent functionality, but also they can be independent to commit their own core functionality. Therefore, it is important to think about how to balance the compatibility as well as keep the independency of products while the function, form, and interaction of products are designed. Taking this into consideration for the challenges, I practised the method of rich, embodied interaction in the course assignments.

I have to mention that the references from the course offer a deep insight and guidance for me to do each assignment. They are not only theories but also good examples for our assignments. There are several

essential theories about rich interactions, affordance, tangible interactions as well as the core and emergent functionality, which were fully applied into the development process of the design concept. After I learned the theories, I realized that there was a lot of design thinking in other projects that were related to many aspects of the theories but they are not systematized and concluded. The feedback and the feedforward as a part of the theory of affordance, is applied in many design works. However, making meaningful feedback was still a big challenge for us during the assignment. There was a difficult time for our group when realizing affordance in our design and creating meaningful feedback to users. I firstly thought about the reason why it may have happened. I thought about the limitation of the context of the home IoT system, but in the end I concluded that there is a lack of contextual information from end users. In other words, the user research is missing in our design process. In order to understand what is meaningful affordance and feedback for users in our design context of co-diet communication, it is necessary to design them based on the users' mindset. For instance, an intuitive manner to users about increasing the amount of calorie is the weight or shape growing, therefore a shape changing from small to big may be a good way as feedback to users in design.

Another reflection is about designing for the growing system. In assignment 2, I didn't start to think of the growing system approach. It hit the concept assignment 2 hard when we moved to assignment 3, since a new topic was added and it was hard to combine them together to present the core functionality of each as well as involving the emergent functionality.

During the developing process from assignment 2 to 3, I reflected on these approaches to design for growth that is hybrid, modular, shape changing, and serviceable and got inspiration from them.

Considering the value I gain from this course together with my PDP, I think my expertise area on Creativity and Aesthesis, User and Society, as well as Design Research were developed. Moreover, I own a valuable perspective as a designer from the systematic theory of the rich interaction.