

Title	Wearing nutrition : designing digital accessory for physical visualization of daily nutrition data
Sub Title	
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Publisher	慶應義塾大学大学院メディアデザイン研究科
Publication year	2021
Jtitle	
JaLC DOI	
Abstract	
Notes	修士学位論文. 2021年度メディアデザイン学 第914号
Genre	Thesis or Dissertation
URL	https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=KO40001001-00002021-0914

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Master's Thesis
Academic Year 2021

Wearing Nutrition:
Designing Digital Accessory for Physical
Visualization of Daily Nutrition Data



Keio University
Graduate School of Media Design

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A Master's Thesis
submitted to Keio University Graduate School of Media Design
in partial fulfillment of the requirements for the degree of
Master of Media Design

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Abstract of Master's Thesis of Academic Year 2021

Wearing Nutrition:
Designing Digital Accessory for Physical Visualization of
Daily Nutrition Data

Category: Design

Summary

Nowadays people pay more attention to their nutrition management, especially because of COVID-19, many people try to eat more healthily. But it's hard to manage each meal and many people think it's inconvenient and boring to read nutrition data or graphs. To deal with these issues, I decided to use digital accessories as a new method to achieve the physical visualization of nutrition data.

This research proposed a digital accessory, named Wearing Nutrition, which combined physical visualization with digital accessories. It would help users manage their nutrition balance when they eat something or pick up something which they want to buy. Users can check the changes of nutritional ingredients simply by the color change or vibration of this bracelet.

In this research, I first analyzed the needs of the target users and gathered requirements for the Wearing Nutrition design from user interviews and literature reviews. Second, based on the user's requirements, the final design concept is proposed, which includes function, interaction, and information presentation design, as well as accessory design. Then, I created several Wearing Nutrition prototypes and evaluated them in user test. Finally, I conducted the three-day user tests with three target users who are young females and have the need to manage their nutrition. Feedback from the participants indicates that the Wearing Nutrition creates an interesting and convenient experience to manage nutrition and makes users get motivated to eat healthier. The wearable visualization of nutrition data also make users have more communication with others about health topics.

Keywords:

physical visualization, data visualization, smart digital jewellery, nutrition data

Keio University Graduate School of Media Design

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Acknowledgements

I would like to express my deepest thanks to professor Masa Inakage, my thesis supervisor, this project would not have been possible without his support and encouragement. His guidance helped me in all the time of research and writing of this thesis. I would like to pay my special regards to assistant professor Atsuro Ueki, for his encouragement, insightful comments, and continuous support. My sincere thanks also goes to assistant professor Junichi Yamaoka for providing me with valuable research suggestions.

Furthermore, I'd want to express my gratitude to my KMD friends who assisted me in completing this project. Many people at KMD, not only the PLAY project members, provided me with a lot of inspiration, assisted me much when I made prototypes, and consistently encouraged me to finish my project. It's a joy to meet these friends at KMD.

I am grateful for the two years I spent at KMD. The knowledge and spirit I gained here will become the sources of strength for me as I confront the challenges of life in the future!

Chapter 1

Introduction

People are paying more attention to their nutrition management these days, and many people are attempting to eat more healthily as a result of COVID-19. However, managing each meal can be difficult, and many people find reading nutrition data or graphs to be inconvenient and boring.

To deal with these issues, I decided to use digital accessories as a new method to achieve the physical visualization of nutrition data. This study proposed the Wearing Nutrition, a digital accessory that combines physical visualization with digital accessories.

It would help users manage their nutrition balance when they eat something or pick up something which they want to buy. Users can check the changes of nutritional ingredients simply by the color change or vibration of this bracelet. Wearable data visualization is also expected to improve users' communication with others.

1.1. Background: Social Trend and Target Needs

1.1.1 Social Trend

Nowadays, many people begin to pay more attention to improving their health. This improvement often starts with changing what they eat. People who eat a well-balanced diet tend to be healthier with stronger immune systems and a lower risk of chronic illnesses and infectious diseases.

Especially during the COVID-19 pandemic, many governments proposed nutrition management as an important way to stay healthy during the pandemic. For example, the FAO (Food and Agriculture Organization of the United Nations) said that good nutrition is very important before, during, and after an infection. While no foods or dietary supplements can prevent COVID-19 infection,

maintaining a healthy diet is an important part of supporting a strong immune system. They encourage people to focus on their nutritional health, such as eating enough vegetables, fruits, and protein foods. Besides the advice from the government, people all over the world also take the initiative to focus more on nutrition management.

1.1.2 Target User Needs

Now nutrition management is a significant social trend all over the world. However, it is quite difficult to manage nutritional ingredients for each meal, such as the amount of fat, sugar, sodium, and fiber that the food has. Many people regard nutrition tracking tools such as food diaries and applications as a normal way in this process. According to the survey, “U.S. adults that would use an app to track diet and nutrition 2017, by age” [1], the typical user of a diet app is young. As of 2017, 17% of 30- to 45-year-olds and 26% of 18- to 29-year-olds regularly use apps to track their diet and nutrition. Besides, in the study of “Who are mobile app users from healthy lifestyle websites? Analysis of patterns of app use and user characteristics”, they found that proportionately more women than men used health apps. [2]

Furthermore, according to my interview and observation, many young females said that they have strong needs to manage their nutrition, but now using the nutrition tracking application or other normal tools can't make them get motivated to manage nutrition. And they think it's inconvenient and boring to read nutrition data or graphs.

From what has been mentioned above, we can come to the conclusion that the young females aged 18 to 29 have the stronger needs to manage their nutrition, so I set the target as the young females aged 18 to 29.

In my survey, completed by 107 target users (female aged 18 to 29), 42% of participants answered they have always and 41% of participants answered they have sometimes been in a situation: They want to manage their nutrition in their daily life, but it's inconvenient to check the nutrition data or it's boring to read the nutrition data or graph from nutrition tracking tools such as food diaries and applications. Existing self-reflection tools on food intake usually require manual logging of dietary information and inadequately support retrospective reviews

beyond the data. [3]

According to my interview with 10 target users, most target users think it is very inconvenient and boring to use the normal method to manage nutrition because 1. They must write down the name of the food or upload the photos to the application. 2. Check the data many times before they want to eat something or buy something. 3. Many people are not good at reading numbers or graphs of nutrition data, nutrition management is regarded as quite a hard task for them, so they can't get any motivation to continue it and tend to give up.

Besides, researchers have recognized that existing statistical design in self-tracking tools for dining experiences may evoke negative feelings, judgment, or obsession. [4]

1.2. Research Goal

The overarching goal of this research is to design digital accessories for the physical visualization of daily nutrition data, which makes it an interesting and convenient thing to manage nutrition every day and makes users get the motivation to eat more healthily.

To sum up three main research questions:

- Q1: Can Wearing Nutrition help users get motivated to eat healthier?
- Q2: Can Wearing Nutrition help users communicate more about health with others?
- Q3: How might we combine the visualization of nutrition data with digital jewelry to provide an interesting and convenient experience of nutrition management?

1.3. Contribution

The main contributions of this work are threefold. First, this research tries to combine the visualization of nutrition data with digital jewelry to provide a new way for target users, young women who are willing to carry out nutrition management but do not have appropriate methods. This research creates a new nutrition

management experience that can help target users achieve their goal of a healthy life.

Second, this project explores how to change the invisible internal data in the body into visible jewelry that can be worn on the human body over long periods of time, aiming to inform the wearer as well as any other person in the immediate vicinity of specific data. Meanwhile this research showcases how to combine "visualization" and "digital jewelry" and what kind of user experience would be created and how it can change the user's behaviors.

Furthermore, in this project, I designed several versions of the prototypes, collected the user's needs, and improved the prototypes many times according to the user's actual experience and user interviews. Finally, through the user's actual wearing experience, the following conclusions were drawn:the Wearing Nutrition creates an interesting and convenient way to manage nutrition and motivates users to eat healthier. The wearable visualization of nutrition data also allows users to communicate with others about health issues more effectively.This project provides a reference for future studies about data visualization and digital jewelry.

1.4. Thesis Organization

This thesis consists of five chapters.

- In chapter 1, as above, discuss the background of this project, including the social trend and target user needs, explain the goal, and give three main contributions of this work.
- And chapter 2 summarizes the past related works from three aspects, including nutrition visualization, smart digital jewelry, and nutrition application. Through comparison, it explains the differences from past works and describes the novelty of the Wearing Nutrition project.
- Chapter 3, depicts the process from ideation to design concept. The final design concept is proposed based on the user's requirements, and it includes function, interaction and information presentation design, and accessory design.

- In chapter 4, three prototypes are built up. I conducted several interviews and user tests to fully understand how target users interpret and respond to Wearing Nutrition design and to investigate how Wearing Nutrition affects people's actions.
- Chapter 5, discusses the limitations and future development of this research.

Chapter 2

Related Works

The overarching goal of this research is to design digital accessories for the physical visualization of daily nutrition data, so at first, this chapter shows some past works about nutrition data visualization by different methods. In addition, this project tries to combine the visualization of nutrition data with digital jewelry to provide a new experience for target users, considering this, some works about smart digital jewelry would be introduced. Then, this chapter analyses the traditional way of nutrition management, nutrition tracking application, and gives the differences from Wearing Nutrition.

Finally, based on the review of the literature and previous works, the summary part gives the novelty of the Wearing Nutrition project and key components of digital accessory design for the physical visualization of daily nutrition data.

2.1. Nutrition Data Visualization

2.1.1 Eye-et

Eye-et (Figure 2.1) is smart eyeglasses for nutrition visualization aimed to support a balanced diet. The goal of this project is to design a nutrition management service that anyone can continue by utilizing the glasses-type terminal smart eyeglass.

Smart eyeglass recognizes the food you peeked at and automatically checks the nutritional components. And based on your nutrition intake, what nutrients and how much will be satisfied when eating it, will be displayed on glasses in a graph.

Eye-et proposes a new way to manage nutrition by the glasses-type terminal, the visualization of nutritional information helps people check their nutrition balance. However, for users, still have to read the graph, this kind of statistical design in

self-tracking tools for dining experiences may evoke negative feelings, judgment, or obsession. [4] So in this research, I try to solve this problem by different data visualization methods.



(Source: Eye-et <https://protopedia.net/prototype/837>)

Figure 2.1 Eye-et

2.1.2 A Postcard from Your Food Journey

In the “A Postcard from Your Food Journey” project (Figure 2.2), they propose a design to transform general food posts into “a postcard from a past food journey”. The postcards are procedurally created from food posts, and encode nutritional values together with the user’s emotional status extracted from photos and texts. [3] Their project extracts nutritional information from food pictures leveraging a food ingredients recognition model and existing nutritional data-sets, and emotional status from textual messages through a meta-learning approach. Then they propose a cartoonish landscape design, which encodes the nutrition and emotion details into the visual elements. The user study shows that the proposed method could facilitate users’ recall of their past experience and awareness of their physical and mental status.

“A Postcard from Your Food Journey” project showcases a non-judgmental casual visualization based on food posting data and shows a good example that non-judgmental casual visualization can make users create a non-judgmental sense of their nutritional intake. [3] This became one of the key components of Nutrition

Tracking Bracelet project.



(Source: A Postcard from Your Food Journey [3])

Figure 2.2 A Postcard from Your Food Journey

2.1.3 Who Moved My Cereal

An interactive web-based visualization for users to select their breakfast cereal and milk options to dynamically understand its collective nutritional value. The goal of this project is to create an effective and dynamic representation of breakfast cereal nutrition based on the choice of cereal box and milk. This project provides a nutrition guide to help people learn more about the cereals they eat and how to make wise decisions and pick healthy items from a variety of choices. Through the interactive visualization “Who Moved My Cereal Bowl,” they want to let people better choose and understand their cereals, nutritional facts, and milk options based on the most famous and sold-out cereal boxes of top brands to actually help them have healthier diets and happier lives.

It is a good example of interactive visualization that is aimed at easing one’s breakfast choices by displaying the nutritional content post selecting the type of cereal and milk consumed from the given cereal wall and milk options respectively.

2.2. Smart Digital Accessory

Smart Digital Jewellery describes adornment artifacts (jewellery) that appear as jewellery and function as computational devices (digital) with a specific purpose



(Source: Who Moved My Cereal <https://www.sritapasyakothapally.me/cereal-nutrition>)

Figure 2.3 Who Moved My Cereal

(smart). Several concepts for wrist-worn Smart Digital Jewellery have been proposed in research. They range from holistic concepts consisting of different pieces of jewelry, such as the wearable mobile phone, where each item implements a specific function, [5] to specific pieces of jewelry, such as bracelets, that are used for, e.g., non-verbal communication [6] [7] or to support daily health practices [8]. This research falls in the area of the design of specific pieces of jewelry. In the following, I present an overview of previous works designed for different goals, including communication, health, and multi-purpose.

2.2.1 Non- verbal Communication

Wearable devices, especially for communication have become very popular. For example, *Ripple*¹ is an accessory worn on the body, which uses computer vision technology. The camera on this product will judge the feeling of the people around and when someone who likes you appears, "Ripple" will tell you by a knock on your back.

1 *Ripple*
<https://tabi-labo.com/281149/feel-ripple>

2.2.2 Inner Data Visualization

More and more works are attempting to express and depict inner data that we cannot ordinarily see.

For example, a research about wearing emotion showed emotions visualized on the body using electronic devices can create an enhanced skin that can be used to activate cognitive processes relevant to social communication, knowledge dissemination, education, and, expanding horizons, interaction with architectures, spaces, people, objects, and the general environment. [9]

2.2.3 Healthy Lifestyle Support

Nowadays with the increase of health awareness, smart digital accessories that help improve the general health of the user, become the development direction.

DnaNudge is a bracelet, using your unique DNA to nudge you towards healthier choices when you're out shopping, by indicating red or green, simply by scanning the product bar code.

The sun protection bracelet Netatmo integrates UV sensors in a metal element and uses a smartphone app as a display.



(Source: DnaNudge <https://www.dnanudge.com>)

Figure 2.4 DnaNudge

2.2.4 Multi-purpose

In the Tangible Apps Bracelet project (Figure 2.5), they investigated how a smart digital multi-purpose bracelet should be designed to be attractive, functional, easily comprehensible, and easy to manage. This includes its appearance, functionality, information presentation, and interaction design. They built the prototypes and finished a lab study, then derived suggestions for the design of multi-purpose Smart Digital Jewellery.

However, now the research for accessories designed for the purpose of nutrition management is still empty.



(Source: Tangible Apps Bracelet: Designing Modular Wrist-Worn Digital Jewellery for Multiple Purposes [10])

Figure 2.5 Tangible Apps Bracelet

2.3. The Features of Wearable Visualization

Researchers have developed various hard and software architectures that can be easily integrated into everyday garments in response to the miniaturization of computing technology and the human desire for pervasive, always-on information access. Wearable visualization, a subset of object augmentation, focuses on the use of miniature computing devices that can be worn on the human body for extended periods of time, with the goal of informing the wearer as well as any other person near specific data. The technology used differs from portable screens on common

mobile devices in that it is specifically designed to be unobtrusively integrated and widely worn. However, the practicality of wearables is frequently undermined by the need for relatively large energy sources to power the displays. Instead of exploring state-of-the-art actuators such as LED lights, electroluminescent wires, thermo-chromatic inks, shape-changing materials such as shape memory alloys, and so on, approaches in wearable visualization tend to experiment beyond the use of pixel-based screens. [11]

Wearable Visualization is a physical artifact that is always present, as opposed to a screen that can be turned off. As a result, these artifacts can occupy a different position in the user's life and thus convey different values to the user than virtually displayed data can. [12]

Because of its opportunistic characteristics and physical proximity to everyday human activities, physical visualization has the inherent ability to directly inform people when decisions are made, to allow people to explore cause-and-effect relationships, and to provide people with enjoyable, but contextually related experiences that can motivate and encourage. As a result, one of the most compelling applications for physical visualization is persuasive computing, which focuses on using modern technology to change people's opinions or attitudes, or to encourage long-term, persistent behavioral changes, by providing real-time information within relevant spatial contexts. [11]

Furthermore, unlike a screen, which can be turned off, physical artifacts are always present. As a result, these artifacts can occupy a different position in the user's life and thus convey different values to the user than virtually displayed data can. [12]

2.4. Nutrition Management Application

There are several applications designed for managing the nutrition data like Asken, Cronometer, and so on. People can input the name of the food or upload photos to the application for getting nutrition information. Although application still has the advantages of high resolution, high user awareness, and cheap use cost, there are still some weaknesses for those applications.

- Users feel bored using it and can not continue.

- Users still need to read complex numbers or graphs. Especially for young girls, they feel inconvenient to read data.
- These applications are designed mainly for weight loss and diet, so it doesn't meet different needs.
- People usually use these applications to record the nutrition data after eating, but it's necessary to manage the nutrition from the time of shopping.



(Source: Asken <https://www.asken.jp>)

Figure 2.6 Nutrition Management Application

As for my project, I designed a digital accessory for physical visualization of daily nutrition data which can solve the above-mentioned problems and provide a new user experience. Users can check their nutritional status just by color change, light, and vibration, by a way of casual visualization. Although compared to application, the pixel-less display might lose in resolution and information bandwidth, it could make up for a richer, more intriguing and memorable experience that nonetheless communicates complex information and insight. [11]

2.5. Eating Culture

Some research discussed that the meaning of eating is not only consuming food, which is basically found in the nutrition chain formed out of carbohydrates, protein, and fats, but also to survive, to get nutrition and pleasure from what we eat,

and to cope with boredom or loneliness [13]. Food is an important part of many people's lives in the world. As human beings burn calories and do activities during the day, they need to consume some amount of food, and this depends on their gender, and thus consuming food is a basic need and with our instincts, we crave some food during our meals. However, what makes us different from other living beings such as animals is that while we consume food, we also form social relationships. In other words, human beings don't just consume food to full themselves; instead eating food is about socializing, people could find a common theme such as food and have a good conversation with that person about the taste, culture or of food with others and thus food is not just a biological or a nutritional need, but it is also required for the maintenance of social relationships [14]. Besides, there has been some research that shows that food functions symbolically as a means to communicate by which one can create, manage and share with others.

Based on these researches, Wearing Nutrition was created not only to assist target users in managing their nutrition but also to encourage people to share and communicate more with others through the physical visualization of nutrition data.

Furthermore, a person's daily habits of eating food aren't just formed out of biological needs; it is indeed formed as a combination of many factors such as culture, gender, religion, and social class. [15] For my design, although these above factors are difficult to change, my design aims to affect users' food choices by sharing and communicating nutrition data.

Especially, as for the target user group, young females, according to the past research, the communication about food is highly related to their eating attitudes and behaviors. [16]

2.6. Summary

This chapter discussed the previous works from three aspects, including nutrition visualization, smart digital jewelry, and nutrition application. To sum up this project's differences from past works:

- There are many kinds of smart digital jewelry designed for various goals, including communication, health, and multi-purpose. And we can find some

works for nutrition visualization using different visualization methods. However, an accessory designed for nutrition management is still empty. This research combines data visualization and smart digital jewelry to create new user experiences and have the first user study on this.

- People use applications as a normal way to manage their nutrition, however, there are some weaknesses including boredom, inconvenience, no motivation, and easy to give up. This project aims to solve these problems.

Furthermore, previous works give some good examples for this research. The literature review and previous work analysis suggested that:

- Non-judgmental casual visualization can make users create a non-judgmental sense of their nutritional intake differently from conventional visualization.
- “Casual”, “artistic” or “information aesthetic” visualization represent information in more pleasurable ways, turning data exploration and insight discovery into an engaging and educational experience.
- The visualization should be interactive.
- Information visualization moves away from its traditional, expert, and computer graphics background, and becomes a social communication medium in its own right. [11]
- Wearable Visualization is proved to be a good way that is always present, unlike a screen that can be switched off. This allows these artifacts to occupy a different position in the user’s life and therefore convey different values to the user than virtually displayed data can. [12]
- A pixel-less display might lose in resolution and information bandwidth, it could make up for a richer, more intriguing and memorable experience that nonetheless communicates complex information and insight. [11]

For Wearing Nutrition project, the main contributions are as follows: first, it attempts to combine the visualization of nutrition data with digital jewelry to provide a new way for target users, young women who want to manage their nutrition

but lack the necessary tools. This study develops a new nutrition management experience that can assist users in achieving their goal of living a healthy lifestyle.

Second, this project looks into how to turn the body's invisible internal data into visible jewelry that can be worn for long periods of time on the human body, with the goal of improving motivation and communication.

Meanwhile in this project, I designed several versions of the prototypes, collected the user's needs, and improved the prototypes many times according to the user's actual experience and user interviews. This research showcases how to combine "visualization" and "digital jewelry" and what kind of user experience would be created and how it can change the user's behaviors.

Chapter 3

Concept

Design concept for a nutrition presentation accessory is developed based on the core target analysis and gathered requirements.

This product combines nutrition data visualization with a digital accessory to create a personalized nutrition data bracelet. Its goal is to provide users with a simple and engaging way to motivate them to eat healthier. The color change or vibration of this bracelet can be used to check the user's nutritional balance. Furthermore, this product creates a new experience for users by allowing them to wear inner data as an accessory on their bodies, as well as improving their communication with others by physical data visualization.

3.1. Ideation

This section discusses how to design Wearing Nutrition, that meets the target user group needs. Before I start designing the Wearing Nutrition, firstly, I identify the target user group and make the user persona, because this part holds the key to the establishment of the design concept and prototype design. Furthermore, according to the user interview and conclusion from the literature review, the next part analyzes the target needs. Finally, this section summarizes the requirements for the following design.

3.1.1 Target Users

Though nowadays there is no denying the fact that a multitude of people pays more attention to their nutrition management, especially because of COVID-19, many people of different sex and age try to eat more healthily.

According to the survey, “U.S. adults that would use an app to track diet and nutrition 2017, by age” [1], and the study of “Who are mobile app users from healthy lifestyle websites? Analysis of patterns of app use and user characteristics”, mentioned in above introduction chapter, the young females aged 18- to 29-year-old have the stronger needs to manage their nutrition. Furthermore, according to my interview and observation, many young girls said that they have strong needs to manage their nutrition, but now using the nutrition tracking application or other normal tools can't make them get motivated to manage nutrition. And they think it's inconvenient and boring to read nutrition data or graphs. So I set the core target as the young girls who want to manage their daily nutrition. [2]

3.1.2 User Persona



Figure 3.1 User Persona

To understand the needs of the target users group -young girls aged 18- to 29-year-olds and determine the design concept and prototype design, this section creates user persona, fictitious representations of members of my target audience

including the following factors.

- Demographics (age, gender, etc.)
- Geographic location
- Career details
- Lifestyle details
- Notes about the problems they face that Nutrition Tracking Accessory could solve

They create a vision of what my ideal customers would look like.

Young females, according to the user persona, are interested in fashion and enjoy sharing their lives with others. These aspects would be the deciding factors in following design.

3.1.3 Needs Analysis

To define the context of use and get the requirements for the following design of Wearing Nutrition, I had an interview with the target user group and summed up the main needs from the literature.

Interviews with Potential Users:

I selected participants from the target group for semi-structured interviews. I interviewed 6 females, between 18-29 years old. Considering the social distance, I conducted interviews using Zoom. Participants were recruited through online public announcements and they were not paid for the interviews.

I asked participants some questions about their experience with nutrition management and the problems they faced when using normal nutrition management tools, like nutrition tracking applications. For 6 participants, all of them have used normal nutrition management tools and none of them owned a piece of smart digital jewelry but all of them wear accessories in their daily life.

Some user pain points were gathered by the interview:

- Boring: When using normal nutrition management tools, they feel bored, especially when they need to read various complex data or graphs. One

participant who is a university student said she used three more kinds of nutrition tracking applications, but she feels that she seems to carry out a task every day, so in the end, she gave up using any application. Another girl said she is not good at reading data, so the complex nutrition data makes her get confused.

- Convenience: They have to enter data where required or upload a picture for each meal and can not check the nutrition balance whenever. 6 participants all felt that it is inconvenient to use normal nutrition management tools.
- Motivation: They hardly get the motivation to eat healthier by using normal tools. All participants stated they would ignore the reminder from some nutrition tracking application.
- Persistence: 6 participants said they thought it is hard to persist in managing nutrition.

Based on the pain points and user persona, combining nutrition data data visualization and smart digital jewelry is anticipated to be a viable nutrition management method for young females who prefer fashion items and want to share their visible nutrition data with others.

To summarize the reasons for using digital jewelry to convey nutrition data, as the Figure 3.2.

In the following section, user interview will be conducted to evaluate this design concept.

I showed 6 participants some pictures of previous works including nutrition data visualization and smart digital jewelry, and asked them to imagine a product combining nutrition data visualization and smart digital jewelry. I asked 6 participants to give their expectations for a new nutrition management tool.

Expectations for a new nutrition management tool

- The product should be a novelty, high-tech, and futuristic accessory with some special functions.
- A quick operation: nutrition information should be displayed discreetly and simple to check.

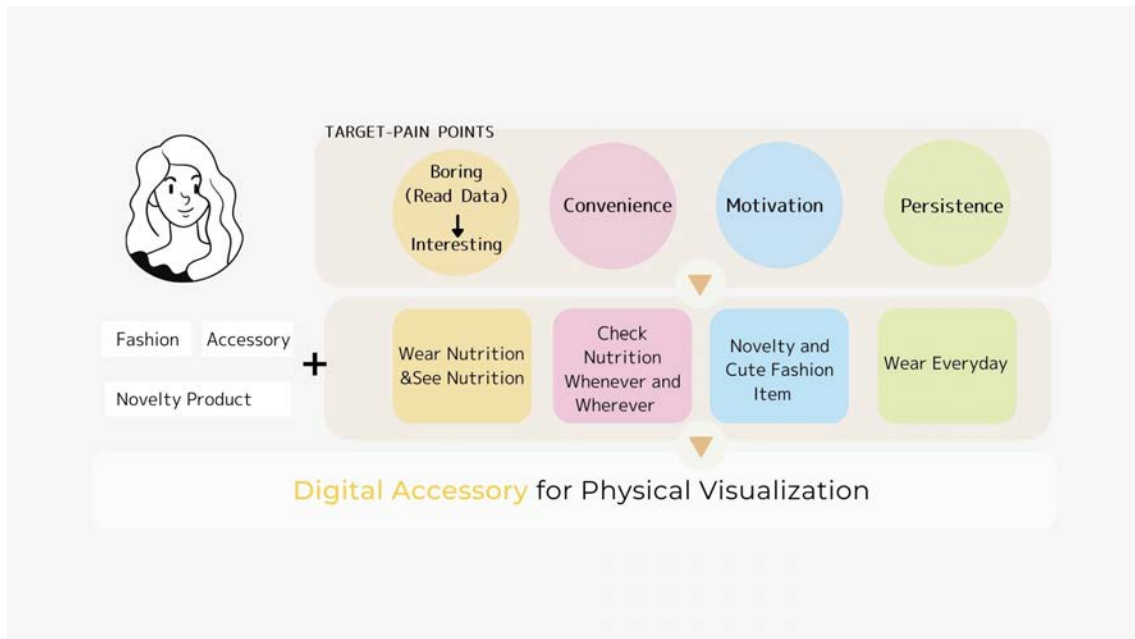


Figure 3.2 Pain points and solutions

- They expect that the product could record the nutrition data automatically and give them advice for food choice.
- Customizable: people can choose different nutritional elements to manage according to personal preferences.
- The appearance of the bracelet is an important factor.
- Users expect that the appearance should be different from traditional accessories.
- Some cool factors on accessories, such as colorful light are needed.
- Bracelet is a good choice to carry message.
- The information presentation design should be attractive.
- Small size and lightweight.
- Make people feel interested in a healthy lifestyle.

- Easy to share the nutrition information with others.

According to the above user interview, most of the users have high expectations for the new product combining nutrition data visualization and smart digital jewelry.

Literature Review

Some general needs were gathered by literature review.

I summarized the requirements for information presentation and interaction design of Wearing Nutrition gathered from the user interviews and literature review as the following list.

- A quick operation, a long battery life, a good appearance, high wearing comfort, a solid and lightweight construction, and the integration of several features into one object, are the most important requirements for a Smart Digital Jewel. [17]
- Bracelet is seen as an individual, personal item that needs to offer a high order of customizability (appearance of bracelet and elements)
- Vibration and light in combination are well suited and liked to present information and give feedback.
- Vibration suits to confirm user input and to gain the user's attention for important information.
- Bracelet needs an invisible mode.
- Bracelet can easily be put on and off.

3.1.4 Requirements Summary

The following list is the summary of user requirements for the design of the Wearing Nutrition gathered by the interviews with target users and literature review.

Function

- They expect that the product could record the nutrition data automatically and give them advice for food choice.
- Easy to share the nutrition information with others.

Information presentation and Interaction design

- The information presentation design should be attractive.
- A quick operation: nutrition information should be displayed discreetly and simple to check.
- Vibration and light in combination are well suited and liked to present information and give feedback.
- Vibration suits to confirm user input and to gain the user ' s attention for important information.

Accessory Design(Appearance, Material, Color, and Customization

- The product should be a novelty, high-tech, and futuristic accessory with some special functions.
- The appearance of the bracelet is an important factor. Users expect that the appearance should be different from traditional accessories.
- Bracelet is a good choice to carry message.
- Bracelet needs an invisible mode.
- Bracelet can easily be put on and off.

Material

- A solid and lightweight construction
- High wearing comfort

Color

Some cool factors on accessories, such as colorful light are needed.

Customization

People can choose different nutritional elements to manage according to personal preferences. Bracelet is seen as an individual, personal item that needs to offer a high order of customizability (appearance of bracelet and elements).

In the next section, design concept is developed based on these requirements.

3.2. Design

According to the gathered requirements, including function, information presentation, interaction design, and accessory design, in this section, I developed designs for Nutrition Tracking Accessory.

3.2.1 Function Design

Users expect that Wearing Nutrition could record the nutrition data automatically and give them advice for food choice. Furthermore, they hope it could motivate people to have a healthy lifestyle. And many users said they want to share the nutrition information with their family and friends.

Based on the gathered requirements, two main functions are proposed: nutrition forecast before eating and nutrition record after eating.

Firstly, function one is nutrition forecast. when users pick up something they want to buy, the nutrition changes would be forecast and the data is visualized on an accessory to remind the users, so they could decide if they should buy it considering the nutrition balance. People can use this function when they shop in the supermarket or order a dish in the restaurant.

Secondly, function two is nutrition record. The accessory would record the nutrition data automatically for users. Whenever and wherever users can check their nutrition balance conveniently by the visualization of nutrition data.

Through these two functions, the comprehensive management of nutrition is realized.

The following picture Figure 3.3 shows the two main functions.



Figure 3.3 Main functions

3.2.2 Information Presentation and Interaction Design

The results of the user interview and literature review show that the combination of light and vibration as output modalities are well suited and liked to present information and give feedback. The light is suitable for presenting normal information on a piece of jewelry, and vibration signals should be designed to present urgent information and give reminders for users. In addition, users expect simple information display and easy interaction with the accessory. The attractive information presentation and interaction design are also regarded as important factors.

According to past research, non-judgmental casual visualization can make users create a non-judgmental sense of their nutritional intake. In this project, casual visualization would be used.

So LED lights and vibration would be used on the accessory as a way to present information and have interaction with users. For function one, when users pick up something they want to buy, the nutrition changes would be forecast and there are LED light color changes on the accessory to remind the users, so they could

decide if they should buy it considering the nutrition balance. For function two, after eating if the nutrition ingredients such as vitamin C you had gotten today change from zero to 25% of what you should get for one day, so your vitamin C LED light also changes from colorless to 25% part of vitamin C LED light would show color. If the nutritional ingredient reaches 100% of what you should get for one day, it vibrates to remind you.

3.2.3 Accessory Design

Appearance

For accessory design, body location is an essential factor when designing, affecting both the usability and the outlook. According to the previous research and observations in life, smart jewelry designs move towards the wearer's hands and fingers, and selected data sources originating from the wearer's body were preferred. So I choose the bracelet worn on the wrist.

In general, there are several elements on a bracelet. The shape usually is the cube, star, flower, butterfly, and so on. I had a small questionnaire online with target users, and as a result, most of them chose the cute shape. So elements are designed in the shape of a butterfly. Several butterflies are worn to show different nutrition information.

Material

The bracelet should be made of high-quality and lightweight materials. At first, I tried heat-shrink sheets, like in Figure 3.4. But it's hard to make the same size and beautiful shape. Then I also tried out different materials from wood, fabric, acrylic, leather to plastics, as shown in Figure 3.5. I spent much time on material exploration. Finally, I chose frosted plastics. The reason I finally chose frosted plastics as the final material was first, it visually represents my shapes nicely. Secondly, this translucent material shows the LED light well.

And I use the laser cutter to make the butterfly shapes.

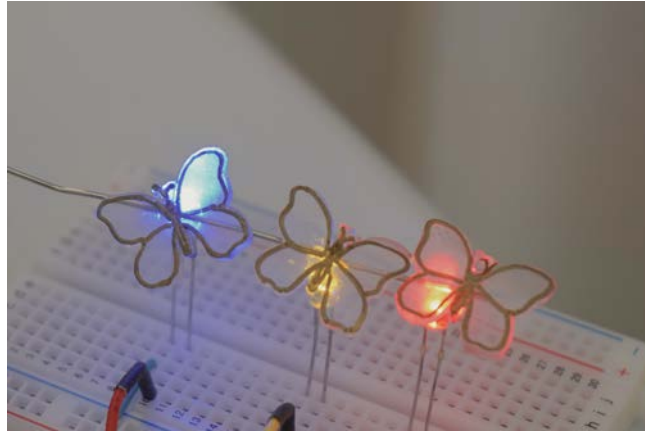


Figure 3.4 Heat-shrink sheets



Figure 3.5 Material exploration

Color

Considering our target group, young girls, they preferred eye-catching design. I used bright colors to present different nutritional ingredients.



Figure 3.6 Color

Customization

Users can choose one to three different butterflies to wear according to their various nutrition management needs.

3.2.4 Scenarios Sketch

The scenarios sketch is illustrated in Figure 3.8, 3.9, 3.10 above show the concept of the project. Users can choose one to three different butterflies to wear according to their various nutrition management needs.

When the users pick up something they want to buy, the nutrition changes would be forecast and there are color changes on butterflies to remind the users, so they could decide if they should buy it considering the nutrition balance. And after eating a meal, the vitamin C you had gotten today changes from zero to 25% of what you should get for one day, so your vitamin C butterfly also changes from



Figure 3.7 Color Design

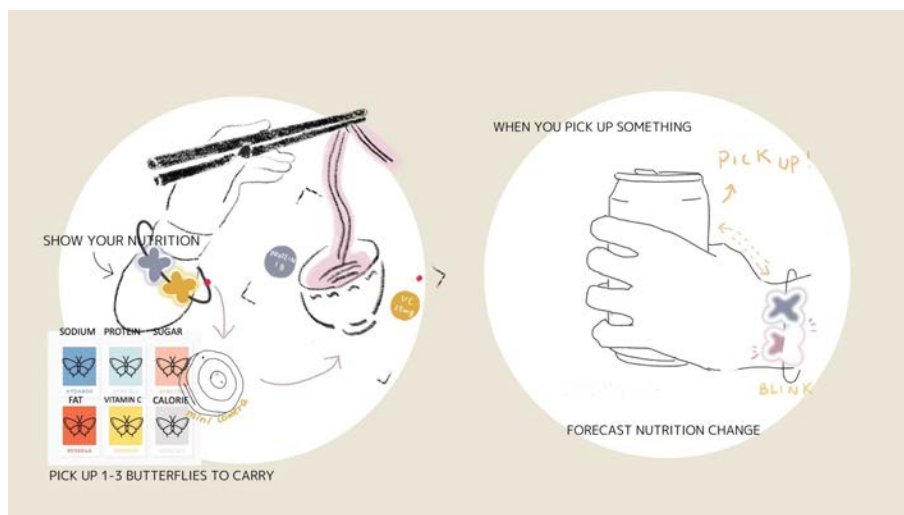


Figure 3.8 Scenarios Sketch 1

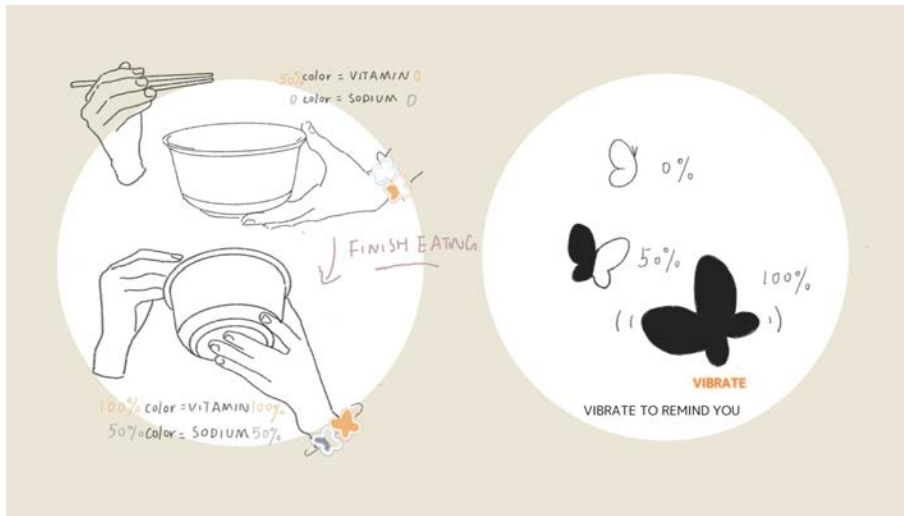


Figure 3.9 Scenarios Sketch 2



Figure 3.10 Scenarios Sketch 3

colorless to 25% part of vitamin C butterfly would show color. If the nutritional ingredient reaches 100% of what you should get for one day, it vibrates to remind you. Users can also use the invisible mode when studying or working.



Figure 3.11 Story 1

The above Figure 3.11 and 3.12 show the vision stories using Nutrition Tracking Bracelet.

Two friends both wearing Wearing Nutrition have dinner in the restaurant. One woman says “ After I drank the juice, my Vitamin C butterfly changed from 50% to 100% ” . After she shared the visualization result of nutrition, her friend also realized the benefit of drinking juice, so she also ordered one.

One person goes shopping in a supermarket wearing Wearing Nutrition. She wants to choose a drink, the bracelet forecasts the sugar for her, so she can easily choose a suitable drink for herself.

3.3. Concept Summary

To sum up the design concept of Wearing Nutrition, it is to combine nutrition data visualization and digital accessory to create a personalized nutrition data bracelet, that aims to provide users with a simple and interesting way which would make



Figure 3.12 Story 2

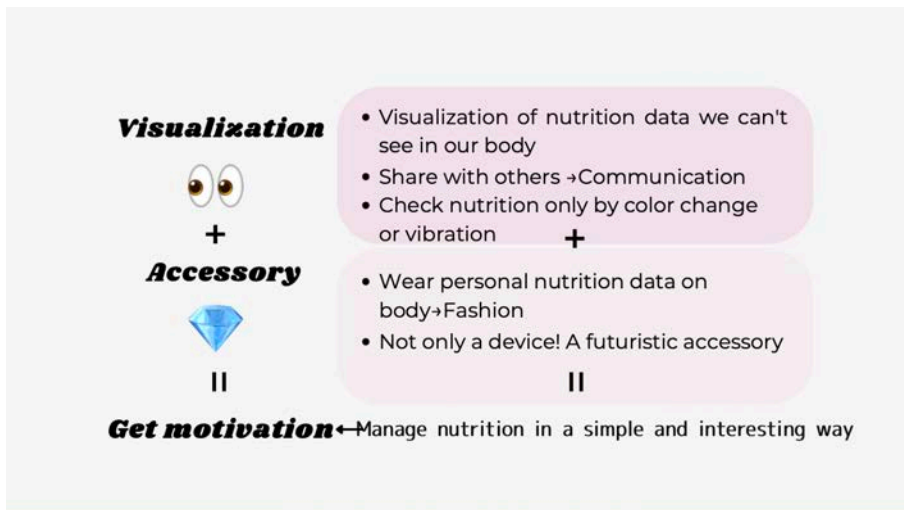


Figure 3.13 Design Concept Summary

them get the motivation to eat more healthily. It is not only a means of tracking their nutrition data and a way to implicitly communicate their health conditions with others. Wearing Nutrition would help users manage their nutrition balance when they eat something or pick up something which they want to buy. Users can check the changes of nutritional ingredients simply by the color change or vibration of this bracelet.

This concept is the basis of my design. In the next section, prototypes are created based on this concept.

Chapter 4

Evaluation

According to the design concept, in this chapter, three prototypes are built up. To fully understand how target users interpret and respond to Wearing Nutrition design and explore how Wearing Nutrition affects people's actions, I conducted several interviews and user tests. The design was improved by the revision of each prototype and following interviews and user tests.

4.1. First Prototype and Interview

The prototype was designed to show the information presentation, interaction design, and accessory appearance design. During the first experiment process, I aimed to achieve the following goals: user interviews with several target users were conducted to explore how people think about this project and get some suggestions for the following prototype building.

4.1.1 Prototype

The first version of the prototype was built using Arduino and several LED lights, in accordance with the experiment goal mentioned above. The bracelet prototype is made up of three different colors. The elements are mounted on a bucket made of metal. According to the color design described in Chapter 3, the blue butterfly represents sodium, the yellow butterfly represents vitamin C, and another butterfly represents the nutritional ingredient selected by the user. Figure 4.1 depicted the prototype's details.

And because I planned to have the interview through an online method, Zoom, considering the COVID-19 situation, I took a one-minute video to help users

understand information presentation and interaction design. This video would be shown to users before the interview.



Figure 4.1 First version of the prototype

4.1.2 Interview and Findings

User interviews were conducted using the first version of the prototype to investigate how users perceive this project and to obtain suggestions for the next prototype.

Participants

Because the Wearing Nutrition's target demographic is young girls, female participants aged 18 to 30 were chosen to participate in this study. Four of the participants are university students, while the other two are working.

Because of the COVID-19, I can't meet with participants face to face, and it's difficult for them to physically wear the bracelet. So these interviews were conducted online via Zoom, and in order for participants to fully comprehend this project, I required them to watch a video of the first version of the prototype, as shown in Figure 4.1. This video demonstrated how the product is used, as

well as the details for information design, interaction design, and the bracelet's appearance.

Each participant took part in a 20-minute individual session. After explaining the project and showing them the video, I asked questions about the Wearing Nutrition using a prepared interview guideline. The following are the main interview questions.

- Q1:What do you think of the information presentation, interaction design, and appearance design of Wearing Nutrition?
- Q2:Do you want to wear this Wearing Nutrition to manage your nutrition?
- Q3:Why are you willing to try the Wearing Nutrition? Why are you not willing to try the Wearing Nutrition?
- Q4: Do you think you would choose to eat healthier when you wear it?

Findings

According to the interview, all of the participants are eager to try the Wearing Nutrition. One participant stated that it is beneficial to her health and that she believes it is beneficial to some people who have diabetes. Another person stated that this product may unknowingly spark her to develop healthy eating habits, and she intends to use it with my friends and share their photos on SNS. In general, they liked the idea of wearing nutrition data as a body accessory.

They regarded the Wearing Nutrition as a cute and novelty accessory that combined practicability and aesthetics in terms of information presentation and interaction design. They thought the combination of LED light and vibration was a good way to display nutrition data. One girl stated that seeing the bracelet shine reminded her to confirm if she could eat more. The appearance was rated as good. The participants thought it was “ A fashion item ” “ Nice-Looking ” “ Bling-Bling! High-Tech, Futuristic ” .

Besides, they also gave some suggestions, like one participant said she hoped it could be more precise and smaller as an accessory. And they want to choose different nutritional ingredients according to their own needs.

4.1.3 Revision for Second Prototype

According to the interview, for the next prototype design and physical user test, the revising points are summed up as follows.

- People should have a real experience with this product.
- Create a scenario to make participants interact with this product.
- The prototype should look more precise and smaller as an accessory.
- The LED light should be brighter and lasts longer.

Based on the revising points, in the next section, a new prototype was built up, and using it I had user tests in KMD Forum with target users.

4.2. Second Prototype and Test in KMD Forum

I conducted a user test in KMD Forum 2021 on Saturday, July 3 and Sunday, July 4 to fully understand how target users respond to Wearing Nutrition and to investigate how Wearing Nutrition affects people's behaviors. During the process, 31 people had a stimulating experience with Wearing Nutrition, filled out a questionnaire, and participated in an interview. According to the observation, questionnaire, and interview results, nearly all participants gain motivation to eat healthier, communicate more healthy topics with their friends or family, and they felt that managing nutrition in this way was an interesting experience.

4.2.1 Prototype

Based on the previous prototype and revision, I designed the second prototype for the physical experience in KMD Forum. Because nowadays, the existing technology can not fully realize the functions and my research aimed to examine the user experience, this new prototype would provide the simulative user experience for participants. The second prototype was designed to achieve these goals: (1) Digital-interactive prototype: Users can wear the prototype to pick up food and

see the visualization result of nutrition change on this prototype. (2) The information presentation and interaction design should be shown clearly. (3) Users can wear the prototype physically on the body to feel the size, weight and enjoy the fun of wearing personal data as an accessory on their body.

5StickC(Figure 4.2)

To achieve the above goals, I used M5StickC, a mini M5Stack, powered by ESP32. It is a mini-size IoT development board that is suitable for wearable devices.

Lilypad LED(Figure 4.3)

Besides, I chose the Lilypad LED because it is small and the color is also bright, and the several colorful Lilypad LED lights were attached to one butterfly to show the nutrition information.

Butterfly(Figure 4.4)

Considering the bracelet should be made of high-quality and lightweight materials, I chose frosted plastics. which visually represents my shapes nicely and this translucent material shows the LED light well. And I use the laser cutter to make the butterfly shapes.

The elements were assembled like Figure 4.5.

A video (Figure 4.6) using the second prototype is made to introduce this project and show the audience how to use Nutrition Tracking Accessory.

4.2.2 Test and Findings

Material

I used the above-mentioned prototype for the user test. To investigate how target users respond to Wearing Nutrition and how Wearing Nutrition affects people's behaviors, I had participants complete pre-prepared questionnaires on my iPad and then conduct a face-to-face interview with them after they used Wearing Nutrition.



Figure 4.2 M5stickc

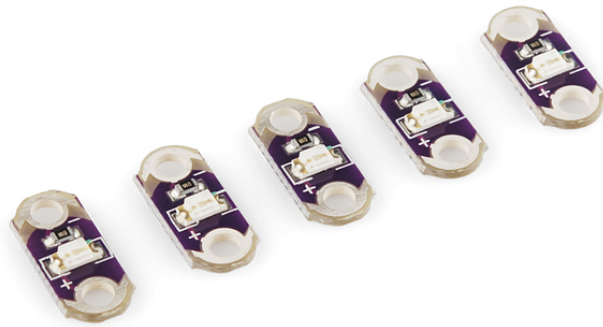


Figure 4.3 LilyPad LED



Figure 4.4 Butterfly

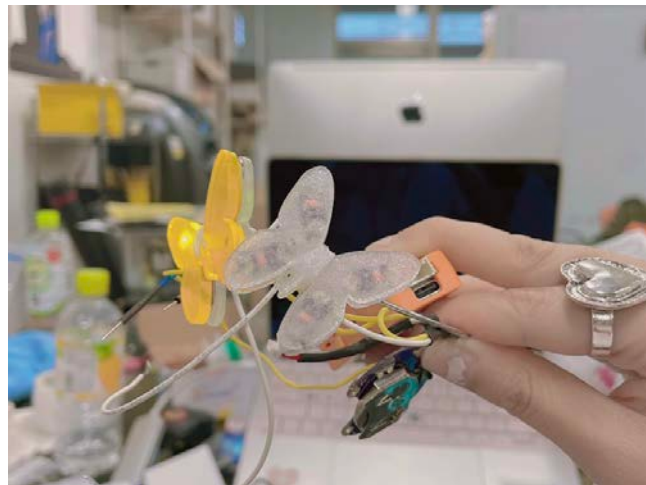


Figure 4.5 Prototype



Figure 4.6 Video

Setting-up

The bracelet was placed on a display table, and visitors are free to wear it. An orange has also been prepared, and participants can use the prototype to pick up the orange and see the visualization result of nutrition change on this bracelet. I made a board to display various color nutritional ingredient butterflies, such as pink sugar butterflies, yellow vitamin C butterflies, blue sodium butterflies, and red fat butterflies. There is an iPad to play the introduction video, as well as some photos to show the usage scenarios.

Details of the setting-up were shown in Figure 4.7.

Participants

31 target users took part in this study. They are all females aged from 18 years old to 30 years old. Most of them are ordinary audiences for KMD Forum 2021, and some of them come from KMD. None of them owned a piece of smart digital jewelry but all of them wear accessories in their daily life. Most participants stated that they want to manage their nutrition and have even tried some normal tools, like applications. Participants were not paid for taking part.



Figure 4.7 Setting-up

Procedure

The procedure is shown in Figure 4.8.

First, I inquired about prior experience with nutrition management and digital accessories. After that, the participants watched the introduction video, and I briefly explained the project. Following that, the scenario of use began. I instructed participants to put on the bracelet prototype, which featured a yellow Vitamin C butterfly and a pink Sugar butterfly. I prepared an orange for them, and when they pick it up, they can see the color change of vitamin C and sugar butterflies to learn about the nutrition change.

Users can have stimulating experiences with Wearing Nutrition through the scenario. Throughout this process, I observed and documented their actions. Finally, they are asked some questions about how they feel about this product. Participants were required to rate some questions on a 5-point Likert scale (1 to 5; the higher the more positive resp. agreement).

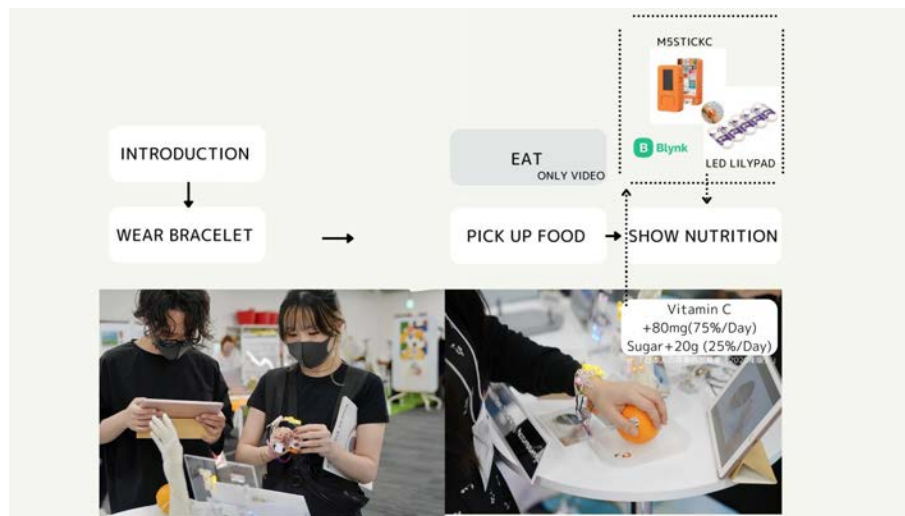


Figure 4.8 Procedure

Findings

According to the observation, questionnaires, and interviews during the user test (Figure 4.9 and 4.10) in KMD Forum 2021, several findings were summarized as follows.

Overall, the Wearing Nutrition was highly rated. 30 participants stated that they want to wear it to manage their nutrition.

Motivation

After participants experienced the bracelet, on a 5-point scale from 1 (“strongly disagree ”) to 5 (“strongly agree ”) 32.3% of participants rated the statement “ Wearing Nutrition can motivate me to eat more healthily. ” with 5. And 58.1% of participants rated 4. (Figure 4.11) Nearly all participants thought that this bracelet would make them eat more healthily. Besides, in the interviews, several people said wearing an accessory to manage nutrition was a new experience for them and they feel more interested in nutrition management.



Figure 4.9 User Test in KMD Forum 1



Figure 4.10 User Test in KMD Forum 2

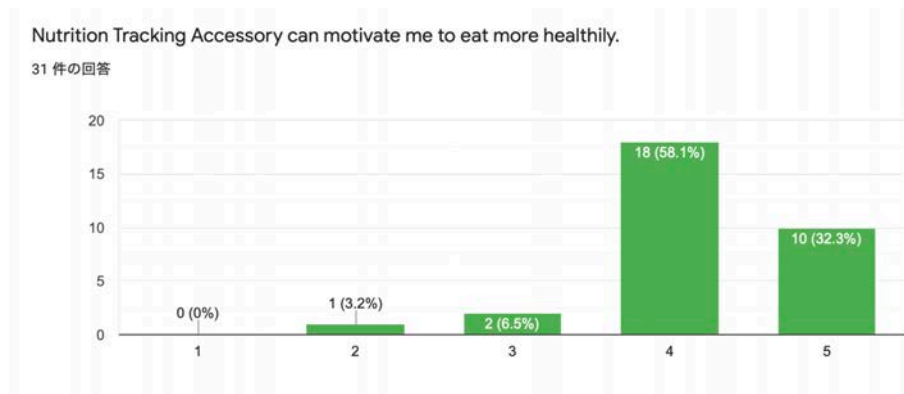


Figure 4.11 Survey 1

Communication

According to my observation, the participants who came with their companions all talked with their companions about the nutrition or health topic when they wore the bracelet. For example, one young university student

Another interesting finding is that one young girl who came alone, discussed her eating habits with me for over 10 minutes, even though I am a stranger to her. The bracelet creates communication between two strangers.

Overall experience

30 participants stated that they would like to wear it to help them manage their nutrition. They liked the overall presentation of information, interaction design, and accessory appearance design. They highly rated the combination of nutrition data visualization and digital accessory. Many participants thought it was funny to wear data as an accessory on the body and to be able to check nutrition data whenever and wherever they wanted.

4.2.3 Revision for Third Prototype

Although this was a physical user test to get the target group's real feedback in KMD Forum, it was still a short time test lasting about 20 minutes. But in order

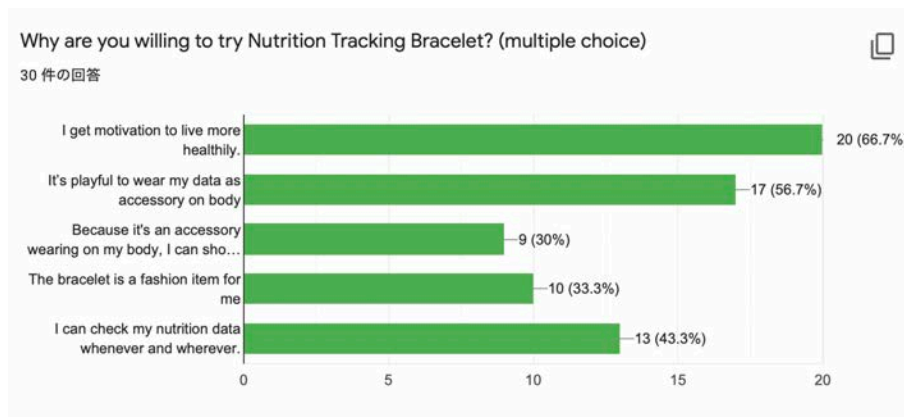


Figure 4.12 Survey 2

to experiment with users in real daily life, the third prototype for the long term is necessary.

- Use a smaller development board than M5StickC
- Use a battery that can last longer.
- Redesign the accessory to make it solid and lightweight.

According to the revising points, in the next section, the third prototype was built up, and using it I had three-day user tests with three participants.

4.3. Third Prototype and Long-term User Test

Despite the fact that the first two versions of the prototypes and experiments received positive user feedback and results. However, considering that this product is closely related to users' lives, the past two experiments were short-time experiments under special scenarios. Some users' responses were obtained solely through questionnaires, interviews, and brief observations. This final experiment will investigate users' real-life use experiences and track the three-day use experience of three target users in order to study the impact of the product on user behavior, what changes the product has made in user life, and identify problems when using

it in real life, in order to provide direction for future research. According to the feedback and results of the previous two experiments, summarize the objectives to be achieved in this experiment, including the following three aspects:

- Observe and record the user experience in real life, so as to summarize whether the product can make the user more motivated to manage nutrition, improve health awareness, and have more communication about health with the surrounding people.
- A long-term 3-day tracking experiment to research the user's behavior changes.
- Test the prototype in real-life scenarios to provide references for future product design.

Because I can't have the closed three-day observation and tests with users during the period of declaration of a state of emergency in Japan, all three user tests were conducted in Shanghai, China, in September and October 2021.

4.3.1 Prototype

The third prototype was the last prototype of this research, which is made on the basis of the first two versions. According to the user experience of the first two prototypes and the results of user tests, the third model is built up after continuous revision. Like the second prototype, due to current technical limits, the prototype still can not show the visualization results according to food in real-time, but after several improvements, the third prototype can provide users with a stimulative user experience. Users can confirm the visualization results of their nutritional data through the bracelet by my background control and actually feel the wearing experience of the bracelet. Moreover, since this experiment was based on the experience of real-life scenes, users will wear this prototype to work, go shopping, eat, etc. like wearing ordinary jewelry. Considering this, the endurance, stability, wearing comfort, and aesthetics of this prototype will be improved than previous versions.

To sum up, this third prototype was designed to achieve these goals:

- Provide users with a complete user experience. They can wear the bracelet in their normal lives.

- The prototype should be suitable for a three-day user test.
- Users can wear it as a piece of special jewelry in daily life.

The following part describes the design details of the third version of the prototype.

Electronic Components

Based on the previous prototype and revision, as a wearable device, the electronic components should be small and the aesthetics when they are attached to the accessory are important. So electronic components exploration was a key part of my third prototype design. Finally, I made the third prototype with the following components:

-Module

The mini size module(Figure 4.13) is used to wireless control the several LEDs on the bracelet to show the nutrition information.

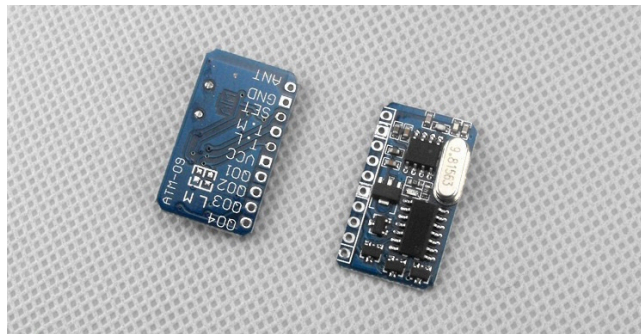


Figure 4.13 Module

-LED

According to the second prototype design and feedback, Lilypad LED is regarded as a suitable LED to be used on digital accessories. The several colorful Lilypad LED lights were attached like Figure 4.14 and 4.15 to one butterfly to show the nutrition information.

-Battery

The bracelet is supported by two small button batteries.



Figure 4.14 LED

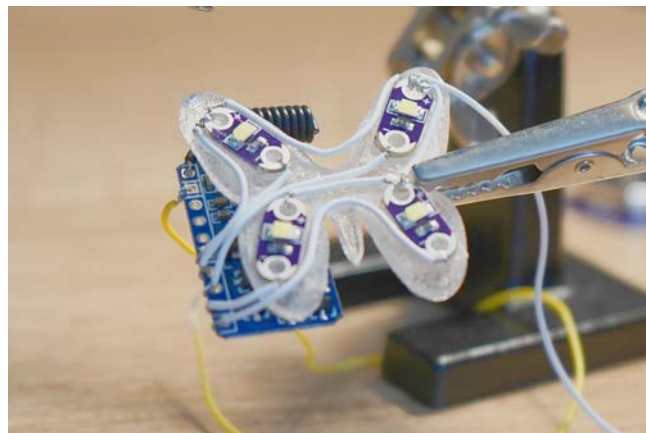


Figure 4.15 LED and Butterfly

Accessory Design

Considering participants would wear it in ordinary life and the experience of wearing nutrition data as an accessory on the body is crucial in this experiment. The aesthetics and wearing comfort of this prototype are important, so during the design process, I tried to use some light and exquisite materials.

The third prototype is shown in Figure 4.16. And I made users try this prototype to confirm they can wear it comfortably in ordinary lives, like Figure 4.17.

The prototype was used in the following three user tests.



Figure 4.16 Third prototype

4.3.2 User A Test

User A

- Female, 25 years old
- OL
- Live in Shanghai, China
- She often wears accessories but never used digital accessories before, and she stated she is interested in nutrition management.



Figure 4.17 User is wearing prototype

Preparation

Because the Nutrition Tracking accessory is designed to meet different needs for nutrition management, I had a small interview with user A, and to know her eating habits, I asked her to take photos of each meal for three days before the test.

1. User A ' s Needs For Nutrition Management

- Recently she had a canker sore, so she thought she needed vitamin b2.

2. User A ' s Eating Habits

- Based on her photos, she tends to eat food with high sugar content.
- She rarely eats fresh vegetables.

According to the prior investigation, I recommend her to wear vitamin b2 butterfly (pink) and sugar butterfly (light yellow), so during the three days, she wore the vitamin b2 and sugar butterfly to manage her nutrition, as shown in FigureXX. And based on the WHO Healthy diet and the user ' s requirements, we set the sugar 240g /day and vitamin b2 1.2mg/day.

The test is conducted from September 25 to September 27, 2021. User A wore the bracelet in ordinary life for three days and I stayed with her to observe and

take notes on her behaviors and communication with others when she wore the bracelet.

Day 1 (September 25, 2021)

1. Breakfast

-Doughnut and Milk

-25% Sugar, 0 Vitamin B2

User A said “ I didn't expect the sugar content of doughnuts to be so high ”



Figure 4.18 User is choosing doughnut

2. Lunch

-Noodle

-40% Sugar, 0 Vitamin B2

Before User A ordered the dish, she checked her bracelet.

3. Dinner

-Fish and Rice

-75% Sugar, 50% Vitamin B2

Before dinner time, she searched online what foods had high vitamin b2 and finally decided to eat fish with high vitamin b2. She picked up one pack of fish to check the forecasting nutrition change.

Before we ended the first day ' s experiment, she checked her bracelet and said “ Today's vitamin intake is not enough. I will do my best tomorrow!! ”

Day 2 (September 26, 2021)



Figure 4.19 User chooses fish

1. Breakfast

-Nothing

-0 Sugar, 0 Vitamin B2

2. Lunch

-Pasta

-25

Before User A entered the cake shop, she checked her bracelet.

3. Dinner

-Fish and Rice

-50

During the dinner, we discussed nutrition intake. We talked about what kind of fruit is good for the body. Although we have known each other for a long time, it was the first time we discussed some health topics such as nutrition and eating habits. She stated when she wears the bracelet, she cares more about her nutrient intake and tries to choose some healthy food.

Day 3 (September 27, 2021)

1. Breakfast

-Hot-and-dry noodles

-10% Sugar, 0 Vitamin B2

She said, “ I chose clothes to match with this bracelet ” .

2.Lunch

-Vegetables and Rice

-35% Sugar, 20

In the restaurant, a waiter asked “ What did you wear on your wrist ” . And User A was active to introduce this product.

3.Dinner

-Crayfish, Lettuce and Rice

-75% Sugar, 70%Vitamin B2

Before she decided what to eat, she said “ Let ’ s eat some food with high vitamin B2 for today ’ s dinner ” .



Figure 4.20 User finished dinner

For the three-day experiment, she never used privacy mode to turn off the light. “ The light on the butterfly is so cool, so I want to show the colorful light to others ” , she said.

4.3.3 User B Test

User B

- Female, 22 years old
- Student

- Live in Shanghai, China
- She wears accessories in daily life but never used digital accessories before.

Preparation

User B is a girl who saw my project introduction video on my SNS account and was interested in it, so I invited her to join my test. Before starting the test, I also had a small interview with User B and asked her to take photos of each meal for three days before the test.

1. User B ' s Needs For Nutrition Management

- She admitted that she had realized she enjoyed eating high-sugar foods, but she had never tried to limit her intake.

2. User B ' s Eating Habits

- High-sugar food.
- Irrational diet structure. She rarely eats fresh fruits and vegetables.
- She was trying 16/8 intermittent fasting for weight loss. (16/8 intermittent fasting involves eating only during an 8-hour window and fasting for the remaining 16 hours)

She decided to wear the vitamin C and sugar butterfly. And based on the WHO Healthy diet and the user ' s requirements, we set the sugar 240g /day and vitamin C 100mg/day.

Test

The test is conducted from September 28 to September 30, 2021. User A wore the bracelet in ordinary life for three days and I stayed with her to observe and take notes on her behaviors and communication with others when she wore the bracelet.

Day 1 (September 28, 2021)

Breakfast

-Nothing



Figure 4.21 User chooses fish

-0 Sugar, 0 Vitamin C

Lunch -Bread and Porridge

-25% Sugar, 0 Vitamin C

“ I know it’s unhealthy to eat high-fat and sugary junk food, but I don’t have time to manage nutrition, so I just choose what I love. ”

Dinner

-Hamburger

-75% Sugar, 0 Vitamin C



Figure 4.22 User is ordering

She checked the bracelet before ordering and she said “ I didn’t intake vitamin c today! I will eat some vegetables tomorrow. I want to see orange butterflies lit up! ”

Day 2 (September 29, 2021)

Breakfast

-Bread

-25% Sugar, 0 Vitamin C

Lunch

-Hamburger and Cola

-75% Sugar, 0 Vitamin C



Figure 4.23 User’s lunch

”I thought managing nutrition was something only my grandmother would do in the past.Now I realized how terrible my eating habits were! And the fashionable bracelet is quite suitable for young people”, she said. She gave up having a drink, and she said “ It seems that I have got too much sugar now.In general, I always have a drink in the afternoon. ”

Dinner

-Rice,vegetables and Doufu

-100% Sugar, 75% Vitamin C

She chooses plenty and a variety of vegetables. After she finished eating, she said “ I can finally see my orange butterflies lit up ”



Figure 4.24 User wear the bracelet to go shopping



Figure 4.25 User checked the bracelet before dinner

Day 3 (September 30, 2021)

Breakfast

-Bread and Juice

-25% Sugar, 25% Vitamin C

“ My mom saw my bracelet. She advised me not to drink milk tea, so I chose juice. ”

Lunch

-Rice+Vegetables

-50% Sugar, 50% Vitamin C

“ I want to see all the lights lit up. It inspires me to choose some food with VitaminC. ”

Dinner

-Noodles

-50% Sugar, 50% Vitamin C

During the three days, our communication always starts with food-related topics, and then we would recommend delicious restaurants to each other, discuss body care, and so on. Before the discussions, we were just strangers on the internet, but through this communication, we became more familiar with each other.

4.3.4 User C Test**User C**

- Female, 25 years old
- Student
- Live in Shanghai, China
- She wears a bracelet every day but never used digital accessories before. She never used any method to manage her nutrition.

Preparation

Before starting the test, I also had a small interview with User C and asked her to take photos of each meal for three days before the test.

1. User C ' s Needs For Nutrition Management

- She was not sure what kind of nutrients she should manage.
- She felt worried about eating enough vegetables.

2. User C ' s Eating Habits

- Irregular eating habits.
- She was busy with her job and had no time to check whether the meal was healthy.

She decided to wear the vitamin C and sugar butterfly and for the third day she. And based on the WHO Healthy diet and the user ' s requirements, we set the sugar 240g /day and vitamin C 100mg/day.

Test

Day 1 (October 5, 2021)

Breakfast

-Nothing

-0 Sugar, 0 Vitamin C

Lunch

-Snack

-25% Sugar, 0 Vitamin C

“ A novel accessory! I hope it can help me eat healthily. I tried some Apps, but I can't continue using them . ” Dinner

-Hotpot

-75% Sugar, 50% Vitamin C

She was busy with her work even have no time to have a meal until 6:00 PM.

She ordered a lot of vegetables and fruits.

Although it was our first time to meet face to face, because of the bracelet, we have a topic to discuss. We talked about our lifestyle and gave some suggestions to each other.

Day 2 (October 5, 2021)

Breakfast



Figure 4.26 Eating dinner

-Milk

-0 Sugar, 0 Vitamin C

“ I remember to maintain a healthy nutritional balance, but I’m unable to eat on time. The multicolored light on this bracelet reminds me to eat on time. ”

Lunch

-Rice, Fish and Vegetables

-25% Sugar, 50% Vitamin C

Dinner

-Rice, Chicken and Vegetables

-50% Sugar, 75% Vitamin C

Day 3 (October 6, 2021)

Because User C said she thought she usually got enough vitamin C, but she doesn’t know if she got enough calcium, so she wants to check it. She decided to wear sugar and calcium (blue) butterflies.

Breakfast

-Bread+Juice

-25% Sugar, 20% Ca (200mg)

“ I remember to maintain a healthy nutritional balance, but I’m unable to eat on time. The multicolored light on this bracelet reminds me to eat on time. ”

Lunch

-Rice and Vegetable

-50% Sugar, 25% Ca

"Today, a coworker offered me a cake, but I declined and showed her my pink butterfly instead." This bracelet assists me in resisting temptation and making it simpler to refuse someone's unhealthy meal.

Dinner

-Rice, Meat

-75% Sugar, 25% Ca



Figure 4.27 After dinner

4.3.5 Questionnaire and Interview

Because, in order not to guide the user's behavior during the three-day experiment, I will purely observe and record the user's behavior and communication, and will not actively remind the user to confirm her bracelet. Therefore, after the three-day experiment, an interview were conducted on the user's opinions on this product.

Hera are the main questions and results.

Main Questions

- What do you think about this product?
- When did you check your bracelet?

- Did you change your food choice while you wear the accessory? And why?
- Did you get the motivation to eat more healthily? And why?
- Did you have more communication with others about health?
- Does the accessory enable you to get interested in nutrition management?
- Are you willing to use it in your daily life?

User A ' Answer

- It looks so cool, I want to share it on my SNS.
- When I choose the restaurant/discuss what to eat with my friend/order dishes/talk about nutrition topics with friends and want to show him/her my nutritional status
- Especially when I finish my hard work, I want to eat some unhealthy food. It's usually a way for self-indulgence. But because I can see my nutrition status, it reminds me to eat some food with Vitamin B whenever and wherever.
- Yes. I can check my nutrition more conveniently! The appearance of the bracelet looks so cool, and it's out of the ordinary. It makes me become a modern girl, using one special product that others haven't.
- I firstly talked a lot about eating habits, food, and body health with my friends.
- It becomes a funny thing to manage nutrition just by wearing a cool bracelet.
- Yes. But now most people don't understand what I wear.

User B ' Answer

- When I first saw it, I was not sure if it's useful for me, but I want to have a try because it's easy to start it just by wearing a piece of accessories.

- When I discuss what to eat with my friend/order dishes/talk about nutrition topics with friends and want to show him/her my nutritional status/be reminded by others /glance at the bracelet
- Because others also can check my nutrition status, I feel some pressure to choose healthy food.
- When my friends or family discuss my health status with me when they see my bracelet, I feel loved and cared for. This makes me do more to keep healthy.
- It helped me start communicating easily with strangers. And I also talked with my family about food choices, we rarely discussed it.
- It's suitable for young people.
- It's playful to wear my data as an accessory on my body.

User C ' Answer

- I feel I become really special after wearing this because it is fashionable and gorgeous. I have the impression that I am at the forefront of fashion. I believe I am using a product that is both innovative and practical. Nutritional management isn't a new concept, but it's fun when it's paired with jewelry.
- When I order dishes/finished eating/be reminded by others /glance at the bracelet
- Before using this, I was unaware of the nutritional components of certain food; but, after using it, I became aware of the nutritional components, prompting me to consider this aspect while selecting food.
- Yes, and I told my female friends about this product. It's a novel product for females to manage nutrition, and it's also quite attractive to wear as an ornament, in my opinion. Furthermore, when others notice my bracelet and bring up the topic of nutritional intake with me, I get the impression that everyone's physical state is different, and everyone's nutritional management goals are different. I'm hoping that future goods will be able to give a wider range of services to meet the demands of diverse people.

- I had never considered nutrition management before, and I was unconcerned about my nutritional intake, but this product piqued my curiosity, sparked an unseen want, and I was willing to begin nutrition management for the first time by wearing attractive jewelry.
- Yes. And I'd like to recommend it to my family and friends.

4.3.6 Results Summary

The results of the three long-term user tests are presented below.

Motivation

- All three users changed their food choice. When they wore the bracelet, they tried to choose healthier foods.
- They checked the bracelet before choosing food.
- Users stated that they are motivated to manage their nutrition, whether they have used other tools such as an application in the past or are trying to manage nutrition for the first time.
- Users said that they would be willing to use it in their daily lives.
- The motivation comes from 1. The bracelet with colorful light reminds them whenever and wherever.2 “It’s playful to wear data as an accessory on my body.” User said. The user is willing to begin nutrition management by wearing attractive jewelry. 3. Nutrition data becomes visible, so their friends or family discuss her health status with her when they see the bracelet, the user feels loved and cared for. This makes her do more to keep healthy. And someone also thinks others also can check their nutrition status, they feel some pressure to choose healthy food.

Communication

- All three users discussed more nutrition intake, food choice, or other health topics with others, including friends, family, or strangers.

- They all stated before they rarely discussed these topics with others, these discussions make them get more motivation to eat healthily.
- However now most people don't understand what they wear so few people took the initiative to talk with them about the bracelet.

Overall Experience

- Participants liked the combination of the nutrition data visualization with digital jewelry. They think it is a special and interesting experience for nutrition management. On a 5-point scale from 1 (“disagree”) to 5 (“agree”) participants scored the statement “Wearing a bracelet is an interesting way to manage my nutrition.” with 5.
- They rated the overall interaction design and information presentation design with the bracelet as very good.

4.4. Exhibition

PLAY Exhibition was held in Gallery Place M, Shinjuku, from December 20th to 26th. About 100 people visited the exhibition. I had the opportunity to talk with them and invited the target users to try out the prototype in order to receive their comments. This exhibition was set up to allow target users to interact with the final prototype and provide feedback and revision points for the next development.

4.4.1 Preparation

Some preparations were carried out prior to the exhibition.

Prototype

The final prototype (Figure 4.28) is revised for the 7-day display to ensure that it conforms for the long-term show. In addition, I modified the bracelet size to ensure that any visitor can comfortably wear it.



Figure 4.28 Prototype in exhibition

Video and Poster

Before visitors experienced the prototype, a one-minute film was made to help them comprehend the idea. In addition, two posters (Figure 4.29 and Figure 4.30) were created to illustrate users the use scenes that were captured during the prior user test.



Figure 4.29 Poster

Comment board

Because during this exhibition, I planned to get feedback from visitors for the following design. One comments board was set up to gather the feedback for this project and expectation for the following design.

4.4.2 Setting-up

Firstly, one projector was set up to play the one-minute concept video. When visitors come into the exhibition space, they would watch this video at first. Then I would have a short introduction about this project. A bracelet prototype was displayed on the model, and I would invite my target user, young females to wear my bracelet prototype. An orange has also been prepared, and participants can use the prototype to pick up the orange and see the visualization result of nutrition change on this bracelet. I made a board displaying various color nutritional ingredient butterflies, such as pink sugar butterflies, yellow vitamin C butterflies, blue sodium butterflies, and red fat butterflies.

Details of the setting-up were shown in Figure 4.30 and Figure 4.31.



Figure 4.30 Exhibition 1



Figure 4.31 Exhibition 2



Figure 4.32 Users is experiencing the prototype



Figure 4.33 Users is experiencing the prototype

4.4.3 Feedback and Expectation

Most of the visitors gave positive feedback, especially for the target user group, young females who experienced the prototype during the exhibition highly rated Wearing Nutrition. Some users expressed interest in sharing their nutrition with friends in this new form, and one user commented, "This would be the future path of development, perhaps in the future everyone will wear their data on the body, it might become a new fashion trend." Many individuals believed it was a fun way to keep track of their nutrition and wear it. They hope to put it to good use one day. There are also certain expectations for the next design. When it comes to "personalization," target users have high expectations. They anticipated that in the next designs, they would have more options for appearance, size and color.

Furthermore, some users anticipate that the bracelet will be linked to social media, allowing them to share their dietary data with a larger audience.

The opinions and expectations will serve as a guide for future design work in the areas of nutrition data visualization and digital jewelry.

Chapter 5

Conclusion

This study proposed the Wearing Nutrition, a new way to manage nutrition by combining casual physical visualization with digital accessory. In this study, I first analyzed the needs of the target users and gathered requirements for the Wearing Nutrition design from user interviews and literature reviews. Second, based on the user's requirements, the final design concept is proposed, which includes function, interaction, and information presentation design, as well as accessory design. In this paper, I created several Wearing Nutrition prototypes and tested them in a user test. According to participant feedback, the Wearing Nutrition creates an interesting and convenient way to manage nutrition and motivates users to eat healthier. The wearable visualization of nutrition data also allows users to communicate with others about health issues more effectively.

However, this work has several limitations.

5.1. Limitation

5.1.1 Technical Limitation

This project proposed the concept of wearing nutrition data as a fashion accessory as a future nutrition management method for target user, young females aged 18- to 29-year-old. In this research, three visions of prototypes were built up according to the target users needs analysis and user 's actual experience. Many user tests in this study using these prototypes demonstrated that this new nutrition management method can encourage users to manage nutrition more dynamically, communicate more with others about health and provide an interesting nutrition management experience for the future of well-being.

Due to the technical limitation, the process of automatically reading and pre-

senting nutritional data is simulated in other ways to provide users with simulation use experience during user tests, because this research focuses on user experience design and testing. The feasibility of the user experience design portion is demonstrated through these user testing.

However, for the technology part, it still requires the real implementation of technology in the future to fully apply this product to real life. With current technological advancements, many companies, such as Sony, have launched automatic nutrition recognition technology. With technological advancement, the development and application of this product in the future is highly anticipated.

5.1.2 Test Issues

Although this design provides casual visualization, the difference between the visualization results and the actual nutrition data in the user test due to technical restrictions may affect users' judgment of their nutritional status.

Furthermore, while this design is committed to providing a personalized nutrition management experience, it is unable to fully meet the various personalized needs of users during user tests. Users also expressed future expectations for customized services according to the interview.

5.2. Future Work

5.2.1 Long-term User Test

A three-day tracking test is carried out in the final user experiment. Users have been wearing bracelets for three days. I observed and recorded their actions and conversations, as well as researched the use of bracelets in real-life scenarios. For diet or nutrition management, as a long-term living habit, a longer wearing experience is better to study the users' habits changes.

5.2.2 Customization

Through the interview, it is found that as a fashionable electronic accessory, young women have very high expectations for its "personalization". In future designs,

different appearances, sizes, and color designs are expected. At the same time, because everyone's physical state and nutritional management needs are different, although this study provides users with services that can choose nutritional elements to wear according to their own needs, customized products based on the difference of individual subtle nutritional needs will become more important in the future.

5.2.3 Social Implementation

Due to technological restrictions, Wearing Nutrition is still difficult to fully implement in real life now. Although, according to this research, the design has been proven to be an attractive and practical way of nutrition management, and the technological restrictions limiting the practicability of this design will be resolved in the near future, based on the analysis of technology research. However, when compared to certain existing nutrition management tools, it is apparent that there are still numerous issues in social implementation to be resolved.

When compared to a mobile phone application with a wide variety of users, for example, the application still has the advantages of high resolution, high user awareness, and cheap use cost.

On the road to social real installation and productization, improving the universality of goods, upgrading product features, and lowering product costs will become major factors to solve in the future.

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