

The food outer packaging can be changed colors according to the degree of fresh with food which put in it. It is aimed at reminding people to reduce the food waste in the method of eating the food before the expire date.

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Abstract

This report outlines the methods and steps taken in the process of researching the project topic, which is aimed at how to reduce the food waste and remind people to eat the food before the expire date in the label through changing outer packaging colors, which according to the fresh degree of the food put in the packaging over the time. Through brainstorming and a series of experiencing prototypes, the participants and I make a conclusion of the final concept and put forward some recommendations for further development, which may be used or discussed in the future similar projects.

Keywords

food packaging, change colors, reduce the food waste, expire best before, fresh

1. Introduction

As the saying goes, 'Hunger breeds discontentment, fresh to the first.' People are increasing interested in ethical, local, and unprocessed foods yet, in some communities, people don't have access to fresh food. The level of consumption of ready foods is raised to a heightened level in line with the fast pace of today's working life. As known, the reason for the spoiling of a food is in contact with the outer environment and which bacteria coming from, then the food begins spoiling and process molding. Another factor which gives harm to the freshness of food, and which accelerates the spoiling process is the moisture in the environment [1] (NALAN and MUMCU, 2012). Supermarket is most common and important way for people to buy food, although the food doesn't reach the expiration date, I found that some of them are not fresh in the supermarket. When people take it back to home, some of them don't take care the fresh degree of the

food, if they eat the stale food, sometimes it will harm their health.

The topic of my project is how to keep food fresh especially vegetables. Then I consider achieving it through the three following ways: improve the packaging, grow in the pot, and grow from the seed. In my opinion, the first one within the previous choices is the most suitable way for me to research, because I have no experience in growing vegetables, and improving the packaging is the most intuitive solution to the problem. Enjoying the fresh food is one of the most essential things for everyone in daily life, who are all involved in it, which influences their physical health. In other words, the worst, and most direct negative influence in eating stale food is people's body will be lack of moisture and nutrition, and which will cause many aches just like stomach. Obviously, there are some further problems need to be explored about the topic. For example, food waste has become one of the severest problems in the

current world with the development of economy, usually people purchase too many things to store at home then forget the best before date in the packaging's label. The focus of the module and report is continuing to research and observe the process, the further step is creating relevant ideas of outer packing to put vegetables and constantly improving the generated ideas. Making an interview with staff in the supermarket is also a good choice as an assistant method to know more about it during the process.

2. Literature review

2.1 Background

At the early stage of desk researching, when I first saw the project 'future food and provenance', I had considered some food related problems in existing situation, one of the most controversial aspects is food waste. There are some different reasons resulting the phenomenon, it's said that 30% of food hasn't been processed that had been wasted because of limited expiration date, the outer packing is also one of the relevant reasons to keep food fresh. When food goes uneaten, the environmental impacts stem from both waste of the resources used to grow the uneaten food and its disposal. The food waste in landfills is converted partly to methane, a greenhouse gas⁴ with 28 times the warming potential of carbon dioxide. Thus, it is estimated that the average American contributes 315 pounds of carbon dioxide equivalent annually (28 percent of all landfill greenhouse gas emissions) by discarding edible food and food packaging (Kling and Hough, 2010) [2] (Schneemann and Oria, n.d.). When the vegetables have been grown up, they will be packaged by people to transport to the supermarkets, every packaging shows the 'Best Before' date, it represents that the best eating time. If the food stored time exceed the time upon

the packaging label, it will get metamorphic in next several days, maybe only one day or two days, if it stores more days, the vegetables' leaves will be rotten. At some time, the refrigerators are stored various kinds of food in messy, which results people difficult to look for their wanted food and forget which one should be eaten in priority.

2.2 Researching direction

Except for the food itself, it is also related to the outer factors, such as temperature, humidity, and breathe or not. All the factors above, it depends on objective conditions and outer packaging designs. It's common that plastic box, plastic wrap, paper bag with small holes and mesh bag exists in the market, these are suitable for different kinds of food, but all of them have their own advantages and disadvantages. For example, Pak Choi should be put in the paper bags with few small holes, this kind vegetable can breathe, if it is stored in closed packaging, its' leaves will be suffocated to turn into yellow, but the packaging with small holes doesn't suit for putting mushrooms, because if the mushroom prolonged exposure to air, it will accelerate decaying in shorten time, so the plastic box with a plastic wrap covered on the top is best suitable for mushrooms. In addition, the mesh bags can be put for the food which can be crushed and exposure to the air just like the oranges and lemons, mesh bags can be put into different shapes, although it can be functioned into breathing, it doesn't suit for vegetables with leaves, which will be crushed into rotten. The direction of my project is aimed at researching vegetables' outer packaging because it can be stored in a short time rather than other food just like eggs and meats whatever season it is, especially the meats can be stored for many days in the refrigerators. Maybe people buy it only for

two days, its' leaves will get into yellow even rotten, but people hasn't aware of it, because people put all the vegetables together. So, we can make some changes in outer packaging, and it better serves as a reminder to tell people enjoy it as soon as possible and which one should be selected first.

It is necessary for me to research the literatures as good examples which can be referenced for my ideas. And I have used the methods of conducting surveys and questionnaires, brainstorming to improve generated plans constantly, quick, and dirty prototyping and analyzing user experience prototypes. Firstly, I want to share the almost principle's example in literature. Microsoft heating and cooking has led to a few smart packaging innovations driven by the desire for greater levels of consumer convenience. Even more sophisticated for microwaveable products that require browning is packaging with data matrix (smart code) barcoding, permitting communication with a smart combination microwave in the kitchen, resulting in microwaveable ready meal precisely heated and browned for the table. I have learned from it is that temperature can play a role in changing the food's ingredients, and it shows in the way of changing colors of outer packaging. As the same principle as the fresh degree of food, the food's ingredients differ from the degree of fresh and stale, and the process from fresh to stale also can be showed through changing colors as the function of better reminding people.

Even if food waste exists in some wealthy places, some poor areas still in the situation of lack of food, there are some factors result the phenomenon, for example, some drought areas don't be suitable to grow vegetables, some remote areas are inconvenient to

deliver vegetables in the aspect of transportation. Using the normal large shipping needs to cost much time from source area to remote areas, the vegetables will be rotten in the process, but using the quick air transportation needs cost much which exceed far more than the cost of the vegetables. The nutrition human needed in daily life comes from various kinds of foods, not to mention the hunger problem. Hunger also leads to measurable economic losses—i.e., further poverty. Lives are shortened, causing lost output and income. Those who survive the effects of malnutrition may be less productive, perhaps throughout their lives. Hunger also often leaves people more susceptible to disease, so that more output must be devoted to health care [3] (Marques and Dhiman, 2020). It is necessary that create new outer packaging to improve the quality of people's life in some areas, because we can't change the objective conditions. There are different methods in packaging researching, for example, create new packaging appearance, labels are temperature or humidity sensitive, change outer packaging color gradually and so on. Those stimuli that have a shiny/glossy visual appearance are typically rated as both attractive and attention capturing. As such, one might have expected that adding a shiny/glossy appearance/finish to the outer packaging and beverage products would also be desirable [4] (Spence, 2021). Since there is a little that can be changed in appearance, through changing the outer color to attract people's attention is also a good direction. At the same time, it is important to make the vegetables can breathe as much as possible, because it is useful for them to be delivered into other remote places.

2.3 Research existing examples in food

packaging

The simplest packaging addition is a thermochromic label. And the temperature sensitive also had been used in 1994, the beer drinkers are all focused on the perfect drinking temperature of the beer, because they discovered the advantages of knowing about it. And the idea was also used, for example, a carling beer can have a logo with the principle of temperature sensitive in the UK, which can be changed colors from silvery or white into blue when the beer's temperature reaches at the best drinking temperature in tasty for beer drinkers (Molson Coors Brewing Company, 2010) (Figure 1).

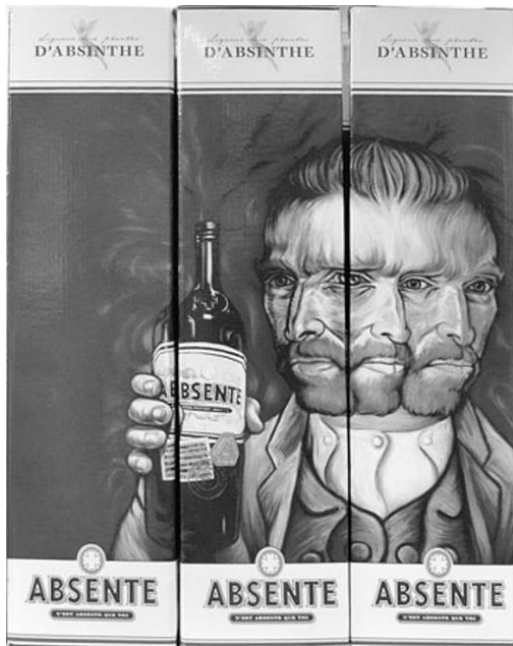


Figure 1: The temperature sensitive drinking can

For the food sector, there are now smart labels that irreversibly change color to indicate temperature excursion (hot or cold), the passage of time, product freshness, produce ripeness or overall shelf-life deterioration for stale food products. They are cheap, reliable, and most rely on the processes of simple diffusion controlled changing colors, which often involved a pH change to trigger an indicator dye. They are

functioned as a means of monitoring food quality and safety is predicted to be helpful in reducing the mounting problem of post-consumer food waste [5] (Yam, 2012). It is a good reference for me to be used in my thought, and I want to use the reference into the food outer packaging, because I think that it will better make the function of reminding people to eat the food as soon as possible.

2.4 Research Findings in other field studies



Figure 2: Nike ultraviolet light shoe

Nike has unveiled a pair of shoes that change from one color to another using ultraviolet light in the past (Figure 2), as well as a T-shirt with a similar design. Two years ago, a heat-sensitive upper was used civilize & Nike sb dunk low, the vamp will appear different colors at different temperatures, it only needs sunlight that can change colors. In one pair, its' effect was so contrasting that almost every vamp had a new color, made up of fuchsia, purple, yellow and blue (Figure 3).



Figure 3: Civilize & Nike sb dunk low

It describes that the concept behind the color,

there are any other projects that have explored color changing to communicate. The technology will become more mature over the time, and with that comes lower costs, which can be more widely applied to the market, the same principle also can be more used in the field of food outer packaging.

2.5 Researching and designing methods

There are many design methods are suitable for me to use in the project, as I mentioned before, I have used the methods of conducting Surveys and Questionnaires, brainstorming to improve generated plans constantly, Researching the related references, Quick, and Dirty prototyping and Analyzing user experience prototypes, these are all helpful for me and used through the whole researching and designing process. The first one: I interviewed with the staff in the supermarket and customer, they told me that the frequency of delivering food from original places to different cities' supermarkets, and how many days food can be stored before best expiration date, in addition that how often the customer go to the supermarkets to buy food and what the habits they stored food at home. Certainly, when communicated with interviewees, I had prepared some questions about the topic to ask to them in advance, and I also documented the changes of vegetables. The second one: Through looking for literatures and collecting research, I found that there were some examples used in the previous, not only in the food packaging, but also in other fields. The third one: I made a list of existing food packing through drawing sketches, one of the eight guiding principles had been mentioned in the module of Service Prototyping, we will generate the idea within drawing sketches, it's a process that translate my thoughts into visualise

pictures, then I made up it into reality as the form of simple prototyping, we need to know that it's a prototype, not the Monna Lisa, which is also one of the eight guiding principles. Quick, and dirty prototyping helps us to experience the advantages and disadvantages of the plan, we can get the feedback of the plan and improve it constantly, so the analyzing user experience prototypes is as the same important as any others.

3. Making and Deployment

3.1 Aimed users and interviewees

At the beginning, I need to know what the user groups that we service for, every project all has a stakeholder mapping, my project— food outer packaging also some relevant stakeholders, such as packaging manufactures, shop owners, farm owners and customers and salesman in Tesco. In fact, everyone is all stakeholder because it influences our daily life, and the latter two are the priorities that I interviewed, they know some details about the food packaging, and all of us are the customer. Staff can help us to analyze and compare the differences between the different outer packaging for various kinds of food in the supermarkets, consumers will go to the supermarket to buy food every few days, they are the ones who benefit most directly and have the most to say. The next step is that I draw the sketches and make up few of them into the low fi prototyping, which will be described and given to the interviewees to use, and they will give the objective feedback to me, then I will continue to modify my design details through their suggestions, certainly, I will also continue to improve my final high fi prototype. Finally, feedback with the final model will also be put forward to me, which is helpful for me or any others who want to continue to do some researchers about the topic, food outer

packaging. Before the designing the outer packaging, the relevant users shared their life experience about why some vegetables can't be stored at home for long time and what the type of packaging is suitable for vegetables to store. The vegetable is the best to store in dry surroundings, in store everything is separated according to the type of food, all fruit and veg is together, all dairy products together, all meat together. Whereas at home everything is put into one place therefore there is more chance of cross contamination. In addition, most vegetables need to breathe, so tight plastic packaging will not be suitable as it restricts this and means they will go off faster. Reusable mesh bag is the other normal option, having loose vegetables in trays allows them to have a bit of space which is key for keeping them fresh, but easy to be squeezed is its' problem. It is necessary to design a better food outer packaging in the future.

3.2 The process of researching (improving the plans)

Before I made up the simple models by hand, I had drawn the initial brainstorming sketches about food outer packaging (Figure 4).

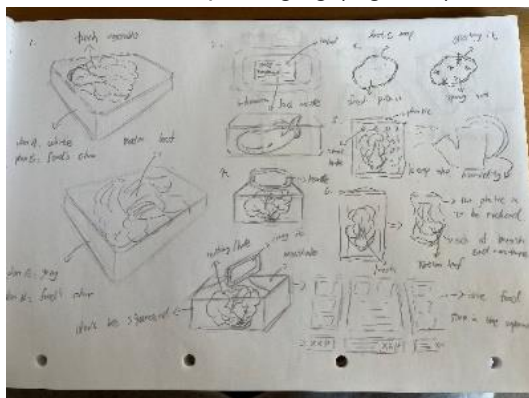


Figure 4: Sketches with initial ideas

Then I choose the most common plastic box (Figure 5) and mesh bag (Figure 6),



Figure 5: Low fi prototyping: Plastic box with handle



Figure 6: Low fi prototyping: Mesh bags with different colours

the low fi prototypes revealed that the preliminary plans always exist some flaws, and we need to improve the plan constantly, because the interviewees and I all can experience the prototyping and find the advantages and disadvantages, take the essence, and discard the dregs for further researching. Prototype early and often is an important principle for designers to make the idea better. And the final plan is always concluded from the previous so-called unsuccessful plans. Then I generated an idea and made it up into simple prototype is that using the plastic box with a hole on the top of the lid instead of using plastic bag, which can make vegetables breathe and add a handle for people to put. But I found that the box with a kind shape doesn't suit for all the vegetables, and the outer circle white plastic isn't good for people to observe. The

previous plastic transparent bag can only open several small holes in the corners, but it can't play a role in breathable, vegetables will be rotten in it if put in much time. Then I found that the mesh bag which normally put fruits like oranges will be used for vegetables, because vegetables haven't fixed shape from the bottom to the root, mesh bags with many holes are suitable for vegetables to breathe. But the users worry about the vegetables will be squeezed and leaves maybe get into rotten, it isn't as the same as oranges, which have a circle thick peel, it doesn't happen that the oranges pulp will be squeezed into orange juice. The above two plans were made up into simple prototyping by myself, and gave them to users to experience, I have invited one staff who works in the Tesco and my roommate who often goes to the supermarket to buy food. Then I got the different feedbacks from them, staff told me that the plastic box is closed and only suit for a few kinds of vegetables just like mushroom, and the plastic bag with holes is often used to put other kinds of vegetables, such as tomato, potato or like Pak Choi, which is consisted of leaves. Any supermarkets are using these two kinds of packaging all the time, although the two are limited and have their own special disadvantages. As for the mesh bag, the staff said that it is used to put fruits, in the aspect of vegetables, maybe only the cucumbers, which have the almost structure with oranges. Different from the context of the feedbacks given by the former, my roommate tries to put other kinds of vegetables into the mesh bags, he said that the ordinary mesh bag is difficult to put the whole Pak Choi, it is limited to put the food with medium and regular shapes, and it looks messy when many mesh bags are piled up in one place. But the mesh bag's handle inspired me that can be used in my idea, it is convenient for users to carry.

As for me, I found that I can combine the characteristics with plastic box and mesh bag, which shows in the form of cube with many holes around the outer packaging.

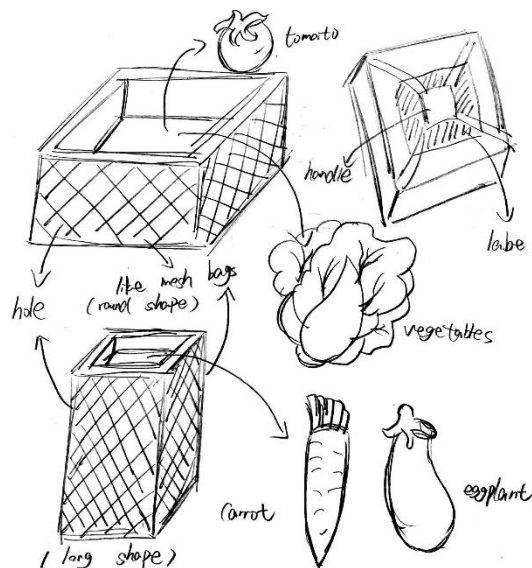


Figure 7: The final idea: The mesh bag with the form of cube

I had sketched up the final idea (Figure 7) before made up it into the high fi prototyping through laser cutting (Figure 8).

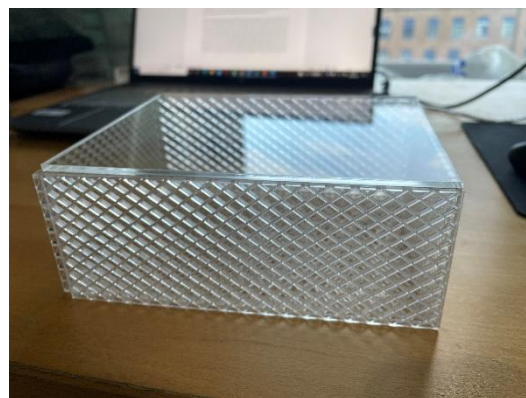


Figure 8: High fi prototyping: Make up the cube through laser cutting

First speaking, users don't need to worry that the vegetables will go off fast in the closed plastic box, because the breathable outer packaging is most suitable for vegetables to be stored and it also wouldn't happen that the vegetables will be squeezed in the plastic or mesh bags, because not all the kinds of

vegetables are as same stress tolerant as the potatoes, it is another important factor for storage. Secondly, the users also hope that the areas put the food looks neat in the supermarket or at home, and it is useful for people to develop the habit of arranging. When I have researched the relatively better outer packaging to store the vegetables, the next is also important, which focuses on how to realize the process of changing colours in the high fi prototyping. Firstly, I need to make sure the colours of my generated idea, I have chosen green, yellow and red. The inspiration comes from the traffic lights, usually in people's mind, green represents health and fresh, yellow has the function of reminding and users need to focus on something, and red means that warning, danger and don't do something. Therefore, choose these three colours, the principle is known to the public. As for me, I use the Arduino advice to simulate the process, which can be visualised presented (Figure 9).

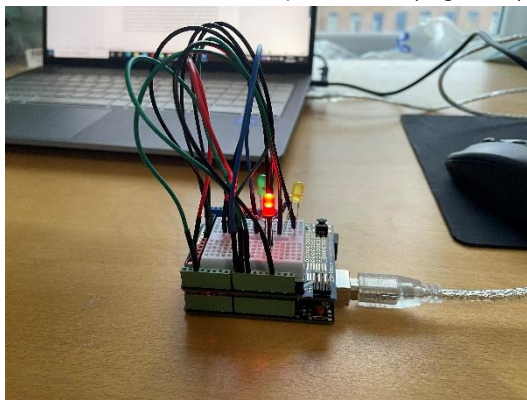


Figure 9: Change the colours through Arduino advice

Finally, I invite my roommates and supermarket staff to test the prototype, because I want to get the feedback about the final idea from interviewees through user experiences, although it can't be put in the store, so the staff can only imagine the circumstance if it will be used in the store according to their working experience and feeling with prototyping. And I also simulate

the circumstance at home for my roommates to experience (Figure 10, 11&12).



Figure 10: Green light represents the vegetables is fresh



Figure 11: Yellow light reminds people to eat the vegetables as soon as possible



Figure 12: Red light shows the vegetable is stale and can't eat

I set the size of it as 16 cm long, 12 cm wide and 6cm high, because the statistics are close to existing food outer packaging.

Certainly, participants have been informed of the workshop in advance and signed the

consent form. The store staff think that it seems like a good idea as it will be more sustainable and environmentally friendly if you can reuse them. It will make it easier for supermarket staff to see what must be wasted, as sometimes out of date products can be missed and left on the shelf for customers to pick up. The red colour would probably be better use for at home or to remind staff to take it off the shelf, as we can't advertise or sell out of date products so maybe keep that in mind. It will also be good for customers as a lot of them look for reduced vegetables (the ones that would be in the yellow stage and about to go off) so it would make it easy for them to differentiate. From the perspective of my roommate who is a consumer, his opinion is that the idea really makes the function as a reminder, and since he uses the prototype at home, he has reduced the unnecessary food waste, which the vegetable is just passed into silence in the food stored areas and more than the expiration of best before date in the label. But he also worries about it can be used widely due to the immaturity of the technology and the concrete cost of the future outer packaging with changing colours according to the fresh degree of vegetables that the internal components will also be changed through the process. Although it still exists other disadvantages, the idea can be referenced in future relevant design. In my opinion, the meaning of the project is that improve the outer packaging in the current market, and it can better store the vegetables for more days, at least keep fresh to the expiration of best before date in the label, and it can also reduce the phenomenon of food waste, which will bring many potential negative effects. The idea is suitable for the supermarket staff to arrange the food and the consumer can better put the food at home, it will improve users' quality of life.

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