Sheep: A lifestyle platform providing access to freshest greens for metropolitan areas through vertical farming system

Xiao Cui
xc2369@rit.edu

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A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Fine Arts in Visual Communication Design

Rochester Institute of Technology
School of Design
College of Imaging Arts and Sciences
Visual Communication Design
Rochester, NY
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Committee Members

Chief Advisor
Adam Smith
School of Design, College of Imaging Arts and Sciences

Associate Advisor
Mike Strobert
School of Design, College of Imaging Arts and Sciences

Associate Advisor
Hye Jin Nae
School of Design, College of Imaging Arts and Sciences
Thesis Approval

Sheep - A lifestyle platform providing access to freshest greens for metropolitan area

Thesis Title
Xiao Cui

Thesis Author

Submitted in partial fulfillment of the requirements for the degree of Master of Fine Arts
The School of Design | Visual Communication Design
Rochester Institute of Technology | Rochester, New York

Adam Smith
Chief Thesis Advisor
Name
Title

Electronic Signature: Use Adobe Acrobat

Michael Strobert
Associate Thesis Advisor
Name
Title

Electronic Signature: Use Adobe Acrobat

Hye-Jin Nae
Associate Thesis Advisor
Name (Optional for some programs)
Title (Optional for some programs)

Electronic Signature: Use Adobe Acrobat (Optional for some programs)

--- select a Title ---

Name (Optional for some programs)
Title (Optional for some programs)

Electronic Signature: Use Adobe Acrobat (Optional for some programs)
Abstracts

With today’s food supply chain, consumers who live in metropolitan areas can not be able to get the freshest greens they want everyday. Main reason is the long transportation between urban city and traditional farms. Based on the research, I found that a new agriculture technology named vertical farming can solve these problems. Because of the main feature of this technique is efficient use of urban space, it can solved the scarcity of land problem. Secondly, the shorter growth cycle can meets the high demand of fresh greens in urban cities. Thirdly, vertical farming can cultivate vegetables which is free of pesticides and contains more nutrients and better taste, this can enhance people’s life quality. So I combined this technology and mobile devices to build a platform which can provide a new access to the freshest greens to people who live in metropolitan areas. The goal of this project is to create a new life style based on the support of vertical farming and experimental constructions in the heart of urban cities. From the design perspective, I focus on the efficient user experience and creative user interfaces.

Keywords

vertical farming, fresh greens, metropolitan area, remote control, transparent trading, user experience, user interface, mobile application
Introduction

Background

With the growth of the population, the freshness of vegetables is becoming a big issue in metropolitan areas. There are several vegetable supplying platforms exist in the market. Most of them provide meal plans and delivery service. But the weakness is consumers have no method to know about where the produces come from, sometimes the produces' freshness is not stable. Some of the platforms ran by real farmers in order to let the customers get vegetable from traditional farms directly, but not all the locations are available, especially urban areas. Another limitation is the influence by season and weather which directly cause the instability of vegetable supplying chain. Each kind of platform has the same issue which is the long transportation and lack of trading transparency.

Problem Statement

Based on today's food supply chain, consumers who live in metropolitan areas get low quality of greens everyday, especially for some people who has high demands for fresh food. And in the larger sense, the whole food supply chain is not healthy and it influences people’s daily life. Moreover, because of the high price of lands in urban areas and the environmental impact, most of the traditional farm is far from people which directly leads to the long transportation between farms and markets. This situation is more sever on vegetables. There are three main reasons which cause the freshness problem in urban cities. First is improper stockpile, markets always stock up unsalable vegetables in the freezers and use chemical liquid to refresh the products. This is why sometimes greens look fresh from outside, but taste like they are expired. Second is long transportation. Generally, greens went through a long journey before customers see them in the market, on average, the travel distance is 2400 kilometers. This is because urban cities are far away from traditional farms. Besides, transport company use refrigerators to keep the food looks fresh. The third reason is low nutrients in leafy greens which cased by pesticides. 5.2 billion pounds of pesticides used worldwide and the intensive agricultural methods decrease amounts of nutrients in the greens. In short, nowadays, most of the ways we get vegetables is not cost-effective and unhealthy.
Context

The implementation of this platform aimed to achieve three objectives: provide access to freshest greens, meet the demand of fresh greens in urban cities and enhance people’s life quality. Based on the research, three approaches were applied in the project for achieving these goals.

Agriculture technology support - Vertical Farming

Vertical farming is a new agriculture technique, it use artificial light, environmental control (humidity, temperature, gases) and other indoor farming techniques to produce plants in vertical layers. It’s not only about how much production can possibly cram into a space, but also about growing better food which can be closer to customers. These are the features of vertical farming:

1) Crops can be stacked as high as the building is built, so it save a lot of space and efficient use of urban space.
2) There would be no more “seasonal crops”, but “year-around crops”. This is because vertical farming technology ensures continuous crop production even in nontropical regions.
3) Indoor growing conditions in vertical farms reduce or eliminate the use of chemical pesticides which is environmental friendly.
4) It is water conservation. Hydroponics uses 70% less water than traditional agriculture. One of the urban water, black water can be recycled and use for indoor farming.
5) A 30-story vertical farm needs 26 million kWh of electricity, but it can generate 56 million kWh through solar energy and the use of biogas digesters. As a result, the source of energy which used in vertical farms is renewable energy.
6) Crops in vertical farms are grown in a controlled environment, and therefore not exposed to extreme weather events like droughts and floods.
7) Vertical farm technique can control the taste of the crops, add nutrient in the crops or even create a eco system to raise fishes in the same building.

In order to fully engage the users and leverage the benefit of vertical farming, there are three approaches can explain how it works. The main feature of vertical farming is efficient use of urban space (crops can be stacked as high as the building is built) which solved the scarcity of land in urban areas. Secondly, the shorter growth cycle can meet the high demand of fresh greens from urban cities. Thirdly, vertical farming technology can cultivate vegetables which contain more nutrients and better taste, this can enhance life quality. Overall, with the support of agricultural technology, people has a brand new access to high quality vegetables. In another word, instead of buying grocery from markets or purchasing online, this technique also bring a new life style which allow consumers grow on demand and harvest on time.
Gamification and planting experience

Management game plays an important roll in today’s mobile game world. There are many games in market which related to farms and planting, such as Hay Day, Township, Bud Farm and Farm Ville. All of these games show great interaction and provide interesting experience. As the one of the inspiration, gamification led to a significant contribution to the success of this application. On the other hand, nowadays, there are many new ways for cultivating plants in real world too. Many people are familiar with hydroponics, the process of growing plants in some type of non-soil based arrangement. Moreover, apartment buildings, offices, hospitals, and countless other structures are now integrating rooftop gardens as a way to help give back to the environment what was lost with construction. (Karin 2017) For recent years, more and more high-technology indoor machines for vegetable planting has appeared in the market, it use water and LED light to grow herbs and veggies in home. As a matter of fact, people who live in metropolitan areas invented various of ways of getting fresh greens and showed big interest in individual farming. For this project, I aim to provide a new platform between vertical farming building and individual urban farmer. In order to achieve the goal of individualization product, let the users get familiar with the new process of growing plants is essential to this application. On the other hand, the high user involvement can not only stimulate consumption desire, but also make this product unique. Users can set the amount, harvest date, customize the ingredients, sweetness and maturity level of the vegetables. While the growing period, users can track the greens’ status on homepage to keep them updated, even monitor the real image by surveillance camera which can improve the user involvement. For the first time user, the waiting time for their first vegetables might be around 20days (average cycle time), they are allowed to visit the market to purchase others' greens for test. Once the crops are ready to harvest, users have four options to deal with it: pick up at the appointed vertical farming building, sell them in the market, deliver or donate to others. These humanization options can let the users make the most of their achievements.

Methods

Background Research

Contextual inquiry is a semi-structured interview method to obtain information about the context of use, where users are first asked a set of standard questions and then observed and questioned while they work in their own environments. (Beyer, H. & Holtzblatt, K. at 1998) I created a questionary which consists of 10 questions in order to get a rough idea of people’s eating habits and consumption concepts. To be more specific, 100% of people has the experience in getting non-fresh vegetables from markets and restaurants; most of the people think the freshness of greens is important to them; more than half of them eat vegetables every day; only a few people are familiar with grocery delivery platforms in the market. From the perspective of consumption level, 60% consumers spent more than 1000 dollars on food every month, 40% spent around 500 dollars. The survey result indicates that the quality of vegetables is a big issue in urban areas and people invest a lot in diet and care about the food quality which directly influence their health.
Target Audience

The target audience of this application is people who live in metropolitan areas and have high demand of fresh greens. To be more specific, the stakeholder can divides into three classifications:

- People who has a strict figure management or has history of obesity.
- People who has medical issue and willing to have a healthier life.
- People who has a family that need fresh greens everyday.

Persona

These personas are based on my google questionaries and personal interviews. I had 5 interviews with people who has different social status. There are three groups of users have high demand of fresh greens and would love to spent a certain amount of money on their diet. Each persona represents a classification of the target audience.

The first representative figure is Helen Sheridan (Figure02) who has a strict body management and history of obesity. Her main pain is she has no time to shopping for veggies frequently but she needs the freshest greens for a morning smoothie everyday. I chose Helen as my first interviewer is because she represent part of the stake holders of this application. The first feature of this type of stakeholder is they has the obesity issue or history and they are concern about their health. Second features is people which do not have enough time to go to the market everyday. In my application, for people who need certain amount of vegetables everyday, users can make a greens plan. Through this plan, the delivery date, time and quantity of veggies are all flexible. It also provide delivery service for people who have no time for shopping.

Figure 01

The second one is Jonatan Emard. (Figure02) He is a successful businessman who committed to the real estate development. Excessive drinking and unhealthy eating habits affected his health seriously and his private doctor gave him some advices that he has to eat more greens and eat on time. His pain is he needs high quality vegetables which contains high nutrients. The feature of this kind of stakeholder is they want to enhance their life quality and has good financial income.
In my application, vertical farming technology can provide the highest quality of vegetables which meets Jonatan’s demand. To be more specific, users can customize the sweetness and ripe level of the vegetables. The lighting and watering system can cultivate the most nutrient crops and multiple taste choices of the produces also enhance people’s life.

The third interviewer is a happy family. (Figure 03) As a mother of three children, Shikha Mahajan is confused that her kids don’t like leafy greens, because it taste awful. She start to spend more time on receipt recently and she need fresh greens to cook everyday. She represent the largest stakeholder of this application because this group of people cook a lot which means they need big amount of veggies. The other feature is they care about the quality of vegetable because they have children to raise.

In my application, the taste choices of greens and customized plans I mentioned above can solve every concern of this interviewer.
User research are inspirational and useful for user experience design and early design process. Based on the data of these three groups of stakeholders, all the users believe that the quality of vegetables is important to them and the current situation in metropolitan areas are not satisfying. Their concerns, pains and needs are valuable information to this application. I chose the main issues and came up with solutions in my design work by providing customized plan and tastes.

**Design goals**

Basically, I aim to create a new access to fresh greens by letting the users be the real “farmer”, for example, planting, monitoring, harvesting greens. All the greens would become real world produces and be planted in vertical farming building located in the heart of urban cities. Once vegetables grown mature, users can “harvest” through online remote control and order the system to deliver the greens. On the other perspective, emotion and interaction engagement are essential components of user experience design. I also aim to design a mobile interactive system which can provide smooth user flows and clean interfaces; provide ease using experience for first time users and returning users. Besides, this application will be only used through mobile phone 24/7. The most important part is get users involved in the whole planting, growing and harvesting process.

**Ideation and development of ideas**

Look at the market, there are several suburban vertical farms exists, but lack of popularity. Based on the features of vertical farming and the greens’ freshness problem in urban city, I got the inspiration that combine this advanced agriculture technology and mobile device to build a platform which can provide freshest greens to people who live in metropolitan areas. To be more specific, in order to fully engage the users and leverage the benefit of vertical farming, there are three approaches can explain how it works. The main feature of vertical farming is efficient use of urban space (crops can be stacked as high as the building is built) which solved the scarcity of land in urban areas. Secondly, the shorter growth cycle can meet the high demand of fresh greens from urban cities. Thirdly, vertical farming technology can cultivate vegetables which contain more nutrients and better taste. This feature can improve the quality of people who has high demand of life. To provide the users the most humanized interaction, the I created an experience mapping by combine the user behavior habits and emotion graph.

The flowchart (figure04) plays an important roll in the design system because it can shows the overall structure of the application. This one consists of three main functions (left part) and what users can do with the homepage (right part). The functions contain plant new vegetables, customize plan and buy or sell vegetables in the market. Because of the gamification of this application, there are many interactions in the homepage(figure). Users can check the growth status through realtime monitor, they can also harvest the crops and there are four options when the crops is ready to harvest, deliver, pick up, sell and donate. To be more specific, If user want the greens, they can choose deliver or pick up; if there’s extra greens, users can sell the greens or donate to people who need help.
Furthermore, after deciding the workflow, sketches (figure05) are drawn on papers for visualize the ideas. This work not only helps confirm the content and layout on every page efficiently, but also reduce repetition work. Through sketching, I can rethink the conceptual thoughts and examine the interface from visual style and functionality. Another advantage which can not be ignored about sketches is they can be used as paper prototype. To be specific, after finishing all the sketch, I utilize the sketches as first time testing material. This is the most efficient way to get the feedback and reduce the misunderstanding from potential users. Based on this usability test, I can refine the sketches and start creating digital files with less UI problems.
Testing and validation of preliminary designs

The major obstacle through preliminary process is to find the balance between mobile management game and functional application. To be more specific, I tried to design based on the normal planting process, for instance, create an unit, drag the seeds, pick another type of vegetables, grow again. The design works deviated from the concept of this application and lead to tons of misunderstanding during the first usability test. After careful thinking, I found out the main reason is she focused too much on the planting process, but ignored what users care about the most. For all the potential users, they are more interested about the vegetable quality and convenient use experience than fancy game experience.

Further refinement and development

To provide a better experience for the users, I informationize most of the visual part during plating and redesign the interface by separating the crops in each panel and showing the related information in the panel. In this way, every time they open this application, user can get the information what matters to them by scrolling up and down the screen. Compare showing the units and seeds on the homepage, this design solution shows a highly understanding about information hierarchy and it is more reasonable and practical for the users. Overall, this is a big challenge to the I because the change need to overthrow all of the design work before and think in a totally different perspective. On the other hand, I learned a lot from this problem solving process. I believes that good design all should based on the strong researches.

Application Iterations - Feedback and Improvement

In order to provide better experience and attract users, well-designed interfaces are essential to this application. Many version has been made during the design process which improve I’s visual design skills and ability of problem solving. Among all the design assets, color choice, location of functional button, hierarchy of information and layout of interface are the main iterations. Below are the comparison of original version and final version. First is about the color choice (Figure06), take homepage as an example, the original color matching is medium green and dark grey which lack of vitality. Based on the usability testing, interviewer found that these two color make them feel the vegetables are not fresh. As a result, I change the color to light green which bring a fresh air to this page. For the notification bar, gradient color makes the information more visually outstanding.

Figure 06
The second iteration is the location of the most important functional button which is the main menu button. Through the two interfaces below (Figure07), I chose the most common location for the menu button, top left corner. Based on the usability test, because of the menu bar covered more than half of the page, this directly influence the readability of this page. I add a button at bottom right corner, this button not only closer to active area, but also more functional. All the information has been visualized and the unnecessary information is be removed. In this case, users can know the main function of pages by the first sight.

**Figure 07**

The third iteration is about hierarchy of the interface (Figure08), take vegetable information page as an example, the original design displays too much information and lack of hierarchy which can easily confuse the users. After careful decision, I analyzes the importance of every information and refine the hierarchy by changing font size and stroke. The final page looks more organized and user can differentiate the importance of the information.
The last iteration which can not be ignored is the layout of interface. (Figure09) To be more specific, the amount of information which can be display in one interface has limitation, same as the space. In another word, utilizing the space reasonably and put the information in the right place are essential for the visual sensibility. The original profile page is not user friendly because of the layout is full of icons, words and grids. The final version are not only more attractive to users because of the graphs and pictures, but also makes good use of space.
Results

Homepage

According to my design goal, I aimed to create simple style and functional interfaces. The homepage (Figure 10) related to every part of this application. Basically, the panels show in the middle are designed to show the growth status of the crops. It contains harvest goal, quantity and fresh level. When the crops are ready to harvest, the harvest button would showed up. From the side menu button, it consists of five main function about this app, plant new, my plan, market, me and help.

![Figure 10](image)

Use Case Scenarios

The first use case (figure 11) is plant a new vegetable. User are allowed to pick one produce at a time, the search button, filter and initial bar can assist the users find the certain vegetable they want to grow. Through the detail page, the quantity, ripe level and sweetened are all editable. User can adjust the quantity by dragging the line in the middle of the dial gauge. After user customized their vegetables, they need to confirm the information and pay for it. In the end, the crop would show up in the homepage. Users can check the greens' status anytime they want. Besides, planting a new crop is the fundament of all the functions of this application, attract their attention and encourage them to grow the first crops is the most important part.
The second case (Figure 12) shows the delivery process. Once the crop is ready to harvest, there would be a notification which reminds the users to harvest. Users have four options to deal with the crops, pick up, sell, deliver or donate. Take deliver as an example, users are required to edit the delivery information. The amount adjustment section could let users separate the amounts of greens to different address. To sum up, the intention of this use case is to show the various options about the crops which reflect the humanization of this application.
The third case (Figure 13) shows the sell process. As I mention before, there are four ways to deal with the crops. Selling option is designed for the user who grows too much vegetables and do not want to waste it. Users can set the amount, price and expired date to complete this deal. Once they edited all of the required information, they can go to the market to check. They can change the price or cancel the deal anytime they want. This function solves the improper stockpile issue.

Figure 13

The last case (Figure 14) is about making greens plan for frequent users. This scenario could be the user who are satisfied with the first growing and harvesting experience and would like to make a plan for a certain produce, or users who find out that they need certain amount of crops on certain day and do not want to repeat the same process. The first page displays the calendar which shows the existing plan, the plan details are below the calendar. After fulfill the required information, users can check next arrival time through calendar. For instance, Helen Sheridan that I mentioned above is a typical younger generation users. She makes herself a veggie smoothie every morning. So greens plan is suitable for this kind of user. She could make a kale plan and set the deliver date or even the time accurate to the minute, in order to get the freshest kale everyday. Take Shikha as an example, she has to cook every weekend for her big family, so picking the greens that her children like and make a plan on every Friday is a perfect choice for her. In either case, greens plan is an organized way to get the freshest vegetables.
My design goal is to create clean and neat interfaces with simple UI elements. The primary color is Pantone color 3385C (R: 71 G: 215 B: 172). This light green is lively, fresh and energetic which reflect the concept of healthy life style. This color mainly used on important notification and active buttons. For the rest of the design, I uses three lightness of grey to finish the design. The intention of this color match is to emphasize the vegetables in this application. All the PNG photos of vegetables I used are free right materials online.

Font choices often set the tone for the whole design and can influence viewers’ feelings toward and interactions with your design. (Janie 2017) I chose Myriad Pro which can display in regular, semibold and bold ways as the main typeface for this application. Besides, the logo use the same typeface as well.
Evaluation & Discussion

Regarding to the problem statement shown above, this application successfully solve the freshness issue of vegetables in urban cities by combining the vertical farming technique and the concept of healthy lifestyle. Not only that, “Sheep” brings the freshest greens into the heart of urban cities which reduce the transportation time; “Sheep” makes the growing process transparent by let users grow their own vegetables through remote control and realtime camera; “Sheep” also advocates a new concept of healthy lifestyle which has been reflected in every details in this application.

The success of this platform is mainly because of the comprehensive researches. In detail, the popular management games provide a clear use case for the “Plant new” function; the competitive analyze about the similar products helps define the unique content and idea of this project; the questionary, in person interview, experience map, persona helps I get more familiar with different users’ shopping habits which is also valuable references for UI design. Overall, complected researches and solid design concept make an important base for the design work.

After finishing the design part, I believe that user testing and surveys can help to improve the applications from many different perspectives. To sum up, all if the participants gave a positive feedback about the workflow and UI elements. They claim that this is an unique application and showed big interest in planting themselves by mobile advices. But the feedback also comes with some concerns which is the long waiting time for the first vegetable that users grow. This concern is because what users grow online is not virtual vegetables, real plants normally take 20 days to grow till matures. And in this period of time, user may lose interest or forget this application easily. In the I opinion, this is a fair complain and it might cause a loss in the future.
Conclusions

This project combined vertical farming technique and mobile devices to build a platform which provided a new access to freshest greens for people who has high demand on fresh vegetables in urban cities. The agriculture technique played an important roll in this application. The main feature of vertical farming is efficient use of urban space which solved the scarcity of land in urban areas; the shorter growth cycle can meets the high demand of fresh greens from urban cities; vertical farming technology can cultivate vegetables which contain more nutrients and better taste, this can enhance people’s life quality. For the application, it only took few steps for the users to plant and harvest vegetables, and they have four ways to deal with the ripe crops based on their demands. Besides, monitor can keep users updated about the growth status. To sum up, Letting the users know about where their veggies come from and how fresh the veggies is can make the trading process more transparent and interesting.

In this study, I learned to leverage the concept of gamification to created a series of functional interfaces for users, meanwhile, balance the game’s process and app’s elements is a challenge to me. Because there’s no similar platforms in the market which means letting the users be familiar with the working process is essential to the success of this application. The strong helping system is designed to solve this concern, users can simply ask for help to get guide and follow the tips which can provide a better plating and harvesting experience.

From the design perspective, I chose minimalism as my design concept. Simple lines, shapes, color usage make all the vegetables pop out. However, by using the simple design elements, this concept also leads to another challenge of this application, which is making the interfaces clean but also user friendly. I learned a lot from this UI problem solving process, leverage the white space and balance the interface hierarchy are the key of the solution.

Concerning future iterations, Sheep is currently limited to adult, but the harvesting and planting experience are also a good education materials for children. As a result, children can also be one of the stack holder because the gamification elements can attract younger generation to get involve with the growth process. Besides, take a wild guess, if vertical farming technology can be used in personal places, people can grow the vegetables in their home without a yard or any other supplement.

In general, with the development of agriculture technology and people’s demand on high quality life, I believed that there’s still lots of potential for this platform to extend.
Appendix

User research questionnaire

"Fresh Food" Around Us

This survey includes 10 questions about your purchasing and eating habits.

*Required

Your gender? *
- Female
- Male
- Prefer not to say

Your age? Location? Occupation? *

Your answer

Who do you live with? Does anyone in your home cook? *

Your answer

Are you on diet? If so, what kind of leafy greens do you like? *

You can list NOT only one Greene.

Your answer

Do you know any existing fresh vegetables delivery platform? What's the name and how do you like it? *

Your answer

How is fresh food important to you? Scale of 1 to 10. *

(1 as the least important and 10 as the most important.)

How much do you spend on food every month? *

- Around $200
- $200 - $600
- $600 - $1000
- Above 1000

How often do you go to the market? *

Your answer

Which market do you usually go to? Why did you choose this market? *

Your answer

Have you ever had experience in getting non-fresh vegetables from markets or restaurants? If so, please briefly describe the situation. *

Your answer

If conditions allow, are you interested in having your own garden to grow the vegetables?

- Yes. It would be rad!
- I'm not sure.
- No (}
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