Swift application design and development:
Application For Food Management

Intermediate Report

by

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1. Abstract

In the project, a management application for Food Management will be developed, pursuing to be a daily management application for citizen with three major features: (1) Simplicity; (2) Intuitive User Interface (UI) and User Experience (UX); and (3) Push Notifications. The application will feature an instant lookup functionality which provides accurate storage information instantly, and a notification to remind the user to manage the closely expired foods and ingredients. It will use core ML to build an ML model, Swift UI for frontend design and PDCA management cycle as a management system. The project is now working on Machine learning models training and will deploy it in the future.
2. Acknowledgement

I would like to express my appreciation to my supervisor Dr. Yip Chi Lap, Beta for his constant encouragement and guidance, and advice to my project which contributed immensely to the evolution of my ideas on the project.
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6. Abbreviations

COVID-19 – Penyakit Virus Corona 2019
FLW – Food Loss Weight
ML – Machine Learning
UI – User Interface
CPU – Central processing unit
GPU – Graphics Processing Unit
iOS – iPhone operating system
7. Introduction

7.1 Overview

Food waste or food loss is a difficult issue on the planet. There are around 100 kilograms of food per person every year squandered at the consumption stage in developed countries [1]. The squandered food disposal in landfills creates greenhouse gases and impact on climate change.

Considering the current pandemic situation, while people are staying at home, more food waste is produced. [2] Staying at home is one of the best ways to maintain a social distance in order to avoid the spread of COVID-19. People seldom leave home during the virus pandemic and they shift their shopping behavior from physical stores to online. Online shopping is the best solution to avoid physical contact and meet their needs by obtaining the benefits of technology nowadays. Online food and beverage orders in the world have increased by 66 percent from March 2020 to April 2020 [3]. The data indicate that individuals have changed their normal shopping habits and show the increasing trend of online purchasing of goods. So, how are these foods and ingredients managed by people?

However, household food waste has increased as a result of people staying at home and maintaining social distance. Research points out that "in most food supply chains, the COVID-19 outbreak has caused significant shocks. From an overall perspective, the crisis showed that the amount of Food Loss Weight (FLW) generated in households increased by 12 percent during the lockdown in Spain in April"[4], meaning that the family has a leak of food management problems. The research also noted that due to the closure of bars and restaurants, the FLW of beverages has increased and the FLW is then reallocated to households in Spain in April [4].

Because of the above situation, providing them with a management tool may prevent them from overbuying and acquiring the ability to respond before the food expires, such as donating food to the food bank or simply finishing the food.

The rest of this progress report is structured as follows. First, the next session outlines the goals of this project, followed by a description of the methodology, including the design and other
supporting features. Next, it presents the schedule and milestones. Finally, with the conclusion of the project plan.
8. Existing products

8.1 NoWaste

Figure 8.1.1 NoWaste application
Figure 8.1.1 shows the NoWaste is an iPhone application developed by KH Creations IVS and designed for iPad. It supports a barcode scanner in a free version, stores at most 200 items and 6 inventory lists. A paid version of the app supports a Pro scanner with access to 335 million products, unlimited inventory lists and expanded storage space from 500 items to 5000 items.

Advantages
- More Accurate to get the food name
- Can search product price and Production place
- Well functions Sort and Search item list

Disadvantages
- Need user input the expiration date
- No Notification function to remind user
8.2 Evaluation

The Food Management Application will improve the existing products mentioned in above by using machine learning to minimize the user input and notify the user to have a better efficiency of management. Combining the machine learning to management system can minimize the human error and reduce the human resource on recording and managing. Perhaps after more iterations of development, the application will be capable of labelling food price with respect to their maturity.
9. Objective

This project aims to concentrate on food identification and label reading from users’ input. It is also our aim to approximate the expiry date of the food by attempting to split one food into multiple mature stages. After a screenshot of the food purchased is taken or reported by the consumers. Ultimately, consumers can receive food notifications on the expected expiry date, or even recommendations on the best day to eat the food.

In order to achieve our goal, the following objectives are our main focuses.

1. **Build a database** that consolidates different food names, food expiration dates, and quantity.

2. **Train a data modal** that classifies the food expiry date with different language labels and the food name from images or videos. The data model is trained using Machine Learning to continuously improve the accuracy of the classification.

3. **Develop a user interface (UI) for users.** This UI will be mobile-base and user-friendly. It will allow users to take photos, set reminder notifications, group the foods, and check the item list with quantity.

4. **Develop a management system** that allows users to plan, check, and act. The user can check the quantity in the mobile app and then get the foods or ingredients really needed.
10. Literature review

Figure 10.0.1[6] shows how the frameworks and application cooperate

Machine Learning is made possible by Apple on the iOS devices. Apple released Core ML in 2017, which allows developers to train and deploy the models of machine learning. The integration between machine learning models and IOS devices are much convenient with Core ML. Besides the Core ML, Vision Framework was released specifically for image processing and label reading. After gathering enough images for machine learning training, testing, and validation, the models generated with the help of Core ML and Vision Framework can be directly implemented into the application. The application solely runs on the device with the great CPU power of IOS devices, so that all the heavy-lifting work will be done in the background. Using the application programming interface (API) provided by Core ML, the models can run with user inputs and generate results to update the frontend components. The application is built based on the Vision Framework and then the Core ML Framework as shown in figure 10.0.1.

Polishing the application is one of the most important works for application development. The frontend provides the interface that directly interacts with the user, that good responsiveness and user-friendly interface give the ultimate user experience. A survey study on why people installing and deleting applications indicated that the core reasons why deleting applications are highly related to user experience[4]. Besides the user experience, only a good interface with the right learnability can deliver all the functionalities to the users. Neither a complicated nor simple interface enables the application’s usability. Thus, it is just as vital to have frontend works along with the backend, promised to serve the utmost from the project.
To sum up, this project is to design and develop a scalable food management system on IOS devices using Swift. Chronically, it helps to foster a better food purchasing habit.
11. Methodology

The project will be split into two parts: the development of iOS apps and machine learning instruction. After some growth on both sides, merging will be carried out, ensuring that the application works properly. The architecture of the application shows in Figure 11.0.1.

![Figure 11.0.1 Architecture of the application](image)

The server will get and send the user data in the application of the iOS device. Users can set whether they want a notification or not. Notification will be received when the food close to expiry dates. Those notifications will be handled by the Notification server. The application will handle image recognition by using core ML.

11.1 Frontend

Prior to coding the logic of the app, app design will be created. An app design sets the structure of the app, that the design generally shows the whole story and the direction of the application. That is essential to have an extensive app design for developers to follow. Sketch Application will be used to create the mobile user interface, which visualizes the interface and interaction of the app. Wired frames also give a better understanding of the flow of the use and the expectation after certain actions. In addition, developers can easily keep track of the tasks and plan with the
design. The design will be updated throughout the development before the final markup is confirmed.

After drawing the design, the interface will be created using Swift with respect to the app design. SwiftUI is chosen for this project because it provides a better solution for this project’s complexity and low learning curve compared to Storyboard. Besides guaranteeing future development, the SwiftUI is able to develop all the user interfaces for all the Apple devices. The storyboard is then less scalable in this perspective, that it only supports iOS devices. However, the downside of SwiftUI is that it is only available for iOS version 13 or above, that the devices under version 13 will not be compatible.

All the functionalities will be implemented using Swift associated with Xcode(-beta). While developing, a Model, View, and Controller architecture (MVC) will be used as the standard software design pattern.

11.2 Management System Design

The management system will be based on the PDCA method used in business. (Figure 10.2.1)

![PDCA cycle for management](image)

Figure 11.2.1 [7] PDCA cycle for management

PDCA is a common method to help people continuously change and tweak what they need to do to achieve the target, in our case it is not buying too much food. Since the application is for daily use, the PDCA method is too complicated to the user. Therefore, we simplify it and implement it in our application. Our management system will allow users to plan and compare the shopping list with the current inventory in their home. A current inventory in their home will be created as
a checklist and it will be simple and easy to edit for the user, including quantity, name, and best before date. The food has the same name, or in the same location will be grouped. The plan list will remind the user that the item should be purchased and not purchased. If the inventory is too high and the expiry date is near, the application will remind the user. Because the application is for daily use, the procedure of the system should be simple and intuitive. Therefore, the user will keep using it.

11.3 Machine Learning

Model training using machine learning is implemented using create ML that comes as a package with Xcode. The create ML provides the interface for Core ML and the Vision Framework that is used to train the machine learning model. After grouping the data images and labeling them, the grouped data can be trained in create ML to generate the model.

Core ML is then used for integrating the machine learning model to the application, as shown in Figure 11.3.1. From the Apple documentation, Core ML provides a unified representation of all models and optimizes the performance of CPU, GPU, and Neural Engine without producing too many memory footprints and consuming much power. [6] Using the application programming interfaces (APIs) provided by the Core ML framework, the application can feed input to the model and get the results from it, so that the application can run the model on its own without any privacy issues.

Figure 11.3.1[6] shows how Core ML works in the graphical illustration
The model can run solely without an internet service on the device, which maintains the privacy of the user. [6] Also, we can continuously upgrade the model to improve the accuracy of food recognition of the application.

In this project, Vision will be employed for image classification. On top of Core ML, there are frameworks, Vision and Natural Language can be applied for instance. Vision can be used to perform object and text recognition, which fits our project goal. [6]
12. Current Stage

12.1 Work Completed

Following works were completed as the first stage of development:
- Basic functions of the application
- Trained Machine learning models
- Initialisation of Data model
- Basic User Interface

12.1.1 Frontend

Figure 12.1.1 Basic User Interface
The Basic user interface is shown in Figure 12.1.1. It has a calendar view mix with a food item list with food name and the expiry date. Users can tap the “+” button in the lower right corner to add food to the food list with image and food name. Also, the user can delete the item by sliding the food list items.

12.1.2 Machine Learning Model

Figure 12.1.2 Details of model trained
Figure 12.1.3 Testing set with picture of oranges

Figure 12.1.4 Testing set with picture of egg
Machine learning model training is currently in version 2, with a total of 17 Classes with 518 images. Figure 12.1.2 shows the model training with 1.4 loss over 12000 iterations, which results in high training loss. In addition, the current model gives an impressive result as shown in Figures 12.1.3 and 12.1.4, with 81% on validation accuracy, both oranges and eggs are recognized using the model. Also, the figures suggest that the model is able to perform multiple recognition with a single image.

12.2 Limitations

![Testing set with picture of banana](image)

Figure 12.1.5 Testing set with picture of banana
In the process of development, there are few limitations on computing power and the input source. The data preparation and the model training take a long time to finish, and thus higher power a computer is needed to borrow from the school. For instance, the above example of training bananas and avocado trained with Macbook Pro 2015 took over 6 hours to finish.

Furthermore, comparing the version 2 to the version 1 of the machine learning model, even though the classes the model is able to classify have increased, the loss from the model is also increased. To minimise loss and accuracy, more images should be gathered for input. Even though the result suggests that there is multiple recognition, in Figure12.1.5, the number of the banana does not match the number of bananas shown in the image. This can be improved by providing more accurate training data.

**12.3 Next Stage**

In the coming stages of the project, working on enhancing machine learning models and finishing all product functions such as text recognition, notification functions will be the objective. The machine learning model needs to improve the accuracy of recognizing fruits and support more fruits.

One of the targets is the user keep using the application in one week. Some users will be invited to experience the application, and collect the feedback from the user to be a guideline of incremental changes to the current application release. The user feedback can help improve the application and keep users using it.
13. Project Schedule and Milestones

The project schedules from September 2020 to Mid-April 2021. Table 13.1 shows the project schedule, and milestone 1 completed and our project is now in the state of milestone 2, user interface design, Machine learning models design and training.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Scheduled Completion</th>
<th>Task Description</th>
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<tbody>
<tr>
<td>Milestones 1 (completed)</td>
<td>End of October</td>
<td>Project study</td>
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<tr>
<td>Milestones 2 (completed)</td>
<td>End of November</td>
<td>Initial preparation</td>
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<tr>
<td>Milestones 3 (completed)</td>
<td>End of December</td>
<td>Preliminary product</td>
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<tr>
<td>(completed)</td>
<td>11-15 Jan 2021</td>
<td>First presentation</td>
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<td>(completed)</td>
<td>24 Jan 2021</td>
<td>Deliverables of Phase 2</td>
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<tr>
<td></td>
<td></td>
<td>● Preliminary implementation</td>
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<td>● Detailed interim report</td>
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Milestone 5 (ongoing) | End of March | Finalized product |
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<tr>
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<td>● Finish all product functions</td>
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<td>● Enhance the machine learning model</td>
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Milestone 6 | Mid of April | Project wrap-up |
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<td>● Optimization and bugs fix</td>
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<td>● testing of the final product</td>
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<td>● Documentation</td>
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18 Apr 2021 | Deliverables of Phase 3 |
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<td></td>
<td>● Finalized tested implementation</td>
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<td></td>
<td>● Final report</td>
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19-23 Apr 2021 | Final presentation |

4 May 2021 | Project exhibition |

Table 13.1 Project schedule
14. Conclusion

Food waste is an imminent waste problem. In this project, a management application on a mobile platform for managing the expiry date of food is proposed, hoping that the source of food waste will eventually be effectively reduced with details of its methodology, development schedule, and others. We hope this project can help the public manage their food and be a wise shopper for the general public.

Project study, preparation, basic UI and first stage machine learning models training is completed for this project. The progress is now working on enhancing machine learning models, implementing all product functions and will follow the project schedule work on the next stage.
15. Reference


