**Summary (one paragraph summary)**

The main aim of our project is to deal with the sustainability of grocery shopping and food wastage from disposing expired groceries. Aided using machine learning, our app will keep track of what is in the fridge, the expiry dates of the users’ groceries and generate a predictive shopping list or recipe based on what is expiring soon.

**Description**

Name of Application: check IT

*(checking what is in the fridge and checking off what is already used/expired)*

**Problems**:

1. What is in my fridge?
2. When is it going to expire?
3. What to buy in my next trip?

**Aim**: Sustainability of grocery shopping by alleviating over-purchasing and reduce wastage from disposing of expired food

1. Reduce wastage from disposing of expired food
   * Reminds users of expiring food
   * Suggests ways to use them before they expire
2. Alleviate the problem of over-purchasing groceries
   * A portable record of their fridge inventory to prevent duplicate purchases of items they already have at home
   * Enable better planning and prediction of shopping list

**Main features**:

1. Keep a list of what is in the fridge
2. Reminder when the expiry date is coming soon and suggesting recipes based on their expiry dates
3. Predicting a shopping list for the next trip

**Target Audience**

1. Young working adults
   * Busy and unable to spare much time in planning shopping lists before going to the supermarket
   * Sometimes buy groceries and just leave it in the fridge to expire if they forget about it
2. Housewives/Househusbands
   * Frequents the supermarket, and this application will make it easier for them to keep track of their fridge inventory with a portable record of it. This prevents duplicate purchases when they forget if they have a certain item at home.
   * The content of their fridge changes often, and this application will provide a simpler way to record and update their fridge inventory.

**Core Functionalities**

1. **What is in your Fridge?**
   * Listing by taking a photo of a receipt - powered by Machine Learning *(Manual input of sparse items by typing)*
   * Output an estimate of expiry dates for most items [Fruits and Vegetables with Imagine Recognition]  
     *(Users can edit this estimate if they are not satisfied with it)*
   * Reminds users if they have items that are expiring soon
   * Constant reminders to check off items through notifications after using items in the fridge
2. **ExpiRecipe**
   * Study your preferences for food based on your purchases and recipes
   * Suggestions will be listed based on your preferences, what items are in your fridge and which items are about to expire.
3. **Smart Shopping List**
   * Users select a recipe they wish to prepare, and a shopping list is generated based on item shortages from the fridge
   * Suggested shopping list will include prices from suggested local retailers
   * **Generation of shopping list based on recurring purchases or food items (Prediction of list based on various data – recurring purchases, items in fridge, age, health, seasons/time, culture etc)**

**Business Model (Feasibility, Market size, Ecosystem, Risks, etc.) \***

Suggested business model - Advertising and Sponsorship (Short-term), and Lead Generation (Long term)

**Feasibility**

There are several gaps faced today in grocery shopping in Singapore. Due to our fast-paced life, grocery shopping has become a big hassle and there is a need for it to be more seamless and integrated.

Solving 3 problems, namely

1. Inability to remember the items in the fridge.
2. Tendency to overlook expiring food items in the fridge
3. Deciding what to purchase in the next trip

Solution to the 3 problems stated

1. Applying computer vision (OCR) to input items in the fridge.
2. Estimating an expiry date and suggesting recipes based on your preferences and the food items expiring soon.
3. Applying machine learning to generate shopping list based on desired recipes and recurring purchases.

By integrating our various solutions, grocery shopping becomes simple and seamless.

Not only does it track your items, use it efficientlyand prepares your next shopping list, it **eventually predicts the subsequent items which goes into your fridge** This closed loop makes the grocery process smarter for busy working adults and **reduces personal wastage of expired food.**

Furthermore, as delivery services of grocers become more prevalent in Singapore, we aim to integrate our app with **grocers to allow quick checkout of products and product recommendations advertisements** by studying consumer behavior.

More importantly, with a larger user base, we aim to effectively target **food sustainability** by reducing food wastage. Through the data obtained from a large pool of shoppers across different grocers in Singapore, we can predict trends and insights of grocery shoppers which we can sell to **large grocers to better forecast their inventory and reduce their wastage and safety stock on hand.**

**Market Sizing**

**Market - Singapore**

Population of Singapore (circa 2017) - **5,708,844**

Number of Resident Households (circa 2017) - **1,289,900**

(<https://www.singstat.gov.sg/find-data/search-by-theme/households/households/latest-data>)

*A resident household refers to a household headed by a resident (i.e. Singapore citizen or permanent resident).*

Resident Employed Households with at least 1 Working Person (circa 2017) - **1,137,900**

(<http://www.tablebuilder.singstat.gov.sg/publicfacing/createSpecialTable.action?refId=15464>)

Resident Employed Households with at least 1 Working Person from age 25 - 54 (circa 2017) - 45% = 512 055

(Assumption that all employed households have 1 smartphone each, have a fridge and purchase groceries)

(Out of Milk - 5 million downloads over international size of 50-100 million potential users = 5 - 10%)

Conservative Estimate - 1-3% of working adults utilize app - estimated 10,241 active users

Average Estimate - 4-6% of working adults utilize app - **25,602 active users**

Optimistic Estimate - 7-9% of working adults utilize app - 40,964 active users

**Ecosystem**

Users

Primary target audience - Working adults in Singapore

Secondary target audience - Housewives/Househusbands in Singapore

Suppliers/Businesses

Grocers in Singapore - Fairprice, Cold Storage, Giant

Potential Partners

Delivery Services specializing in grocery - Redmart, HonestBee, Fairprice

**Risks**

1. Technology cannot be patented, idea can be copied
2. Current apps available on the market provides various aspects of our functionality (shopping list, fridge items, expiry tracker - manually input)
3. Smart fridges seem more integrated with advancement of Internet of Things (IoT)

SWOT Analysis (Compared to Porter’s 5 forces)

* 1. **Strengths**

1. End goal of food sustainability and reduced food wastage
2. Innovative features mainly supported with AI
3. All in one app, centralized and well integrated across features
4. Personalized app for each user
   1. **Weaknesses**
5. Require a large broad base of users for maximum effectiveness
6. Complex algorithms and machine learning technicalities
7. Difficulty for senior aged who are unfamiliar with technology
   1. **Opportunities**
8. Integration with increasing proliferation of delivery services for quick checkout/advertisements
9. Possible improvement in forecasting for user and eventually grocers
   1. **Threats**
10. Technology cannot be patented, idea can be copied
11. Current apps available on the market which serves isolated purposes (shopping list, fridge items, expiry tracker)
12. Smart fridges which seem more integrated with IoT at home

**Benefit for end-users and business partners \***

**End-users**

1. Keeping track of what is in the fridge
2. Knowing when it expires and to efficiently use expiring ingredients through recipe recommendations
3. Knowing what to buy in the next trip through better predictions and planning
4. Simple and seamless integration in one app

**Business Partners**

1. Advertisement opportunities for grocers through product recommendations
2. Insights of data collected from end-users to improve forecasting of groceries
3. Possible integration of delivery services with our app to allow immediate checkout of groceries

**Technical aspects**

*Machine learning*

1. Optical character recognition
2. Image Recognition of food
3. Regression prediction of food expiry
4. Recommendation systems

**Choice of technological stack**

**Machine learning tools**

Google Cloud vision API → OCR API

Google Compute

**Application making tools**

Google cloud bucket

Web app stack → MEAN stack, firebase

Tensorflow Lite → suitable for rapid deployment of machine learning models

**Technical feasibility of project**

1. Performance
   1. Machine Learning Tools:
      1. OCR recognition: At the start, access to data would be difficult. As such we plan to tap on google cloud vision OCR API to do the OCR capturing. In addition, since lesser than 500 API calls is free, this is very suitable for early stage application development
      2. Image Recognition of food: Scrap google images for images of different fruits and vegetables
      3. Recommendation systems: Gather data based on geographic regions first, personal customization will only come in when a critical amount of usage by individual is used
   2. Application making tools:

Google cloud services are high performant with back-up services for their database storage and load balancing inbuilt into them. As such, this is highly suitable for early stage app development

1. Ease of deployment
   1. Machine Learning Tools / Application Tools:

Deploying on a cloud based provider like google cloud simplifies the deployment (load balancing, storage space backup is handled).

1. Interoperability
   1. Machine Learning Tools:

Hosting on google cloud allows us to easily utilise other google cloud services such as google cloud storage, google OCR API, google app engine (app deployment) and google compute (recommendation engine)

* 1. Application Tools:

Hosting on google cloud allows integration with google OCR and all google core machine learning API easily

1. Scalability
   1. Machine Learning Tools:

By utilising Google APIs, we are able to provide quality OCR

Future: Collect user data from app users and use this to train our own model → Reduce cost from using google API, reduce latency in app

* 1. Application Tools:

Utilising google cloud services we are able to scale rapidly whenever we want, grow quickly fast

1. Cost
   1. Machine Learning Tools:

Start: Low utilisation of Google API (<500 API calls) → free to use

Middle: Pay per API call → in the meantime we collect relevant data

End: Build our own in house model → No cost from using Google API

* 1. Applications Tools:

Start: Utilise free $300 google credits

End: Pay per usage, CPU only VM

**Key challenges in development**

*Machine Learning*

1. Problem: Getting the scale of data required for generating an accurate model
   1. Solution:

Initial

* + 1. OCR → Use existing APIs from google cloud
    2. Recommendation engines → Give suggestions based on type of individuals rather than specific individuals
    3. Expiry dates for food → Initial stages we can create a database with common food and expiry dates → refer to that database
    4. Food image recognition → scrap google images for images of different kinds of food

Final

1. Slowly build up the dataset and fine-tune the model consistently → keep updating the model using tensorflow serving

For the machine learning toolkit, we are planning to build on top of existing Google cloud vision API services (specifically the OCR API). This is because at the beginning

1. we do not have the scale of data required to train the machine learning model
2. Free trial for less than 500 API calls every day
3. Easily scale the service according to the demand rather than a fixed cost

For web-app technology stack, we plan to use MEAN stack to rapidly prototype our app. Using the MEAN stack allows us to make web-apps

1. Able to use on IOS and Android
2. Huge community makes the development using these tools easier
3. Google VM have free credits and have integrated storage capabilities
4. Able to scale easily

**Improving machine learning model with time**

Our Application will collect user data and store it into a Google cloud server. This data can then be used to train and improve our machine learning model. In the future with enough scale, we plan to train our own OCR model and serve them into phones using tensorflowLite, a machine learning toolkit used for mobiles. This reduces the cost of API calls and reduces the latency in transmitting data over the internet, also allowing for offline usage of the app.