

R F  OD

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R Motivation

Food waste is indeed a massive global problem. Based on the data from Joseph Poore and Thomas Nemecek's research (2018), food production accounts for 26% of global greenhouse gas emissions. From this number, food waste and losses in supply chains and by consumers is responsible for 6% of the emissions itself. Since food losses during production and harvest on farms are not taken into account in Poore and Nemecek's analysis, the actual figure is probably a little higher. Furthermore, the Food and Agriculture Organization (FAO) claimed that if food waste were a country, it would be the third-largest emitter of greenhouse gases, right after the US and China.



For the case in Korea, according to the National Assembly Research service, the amount of food waste in 2019 was 21,065 tons, up 31 percent from 16,032 tons in 2013. Moreover, food waste at food manufacturing facilities continuously grew up from 1,010 tons a day in 2016 to 1,452 tons a day in 2019. It means that one-fourth of food thrown away in Korea was tossed into the trash without even making it to the table.

Considering how serious the food waste problem is, our team is coming up with the idea of R Food, a computer vision-powered sensor that can detect the quality and freshness of the food so that it will notify the consumers to consume the food before it is getting expired. Our product is

aiming to reduce food waste and building more responsible consumption and production behavior among people.

R Solution

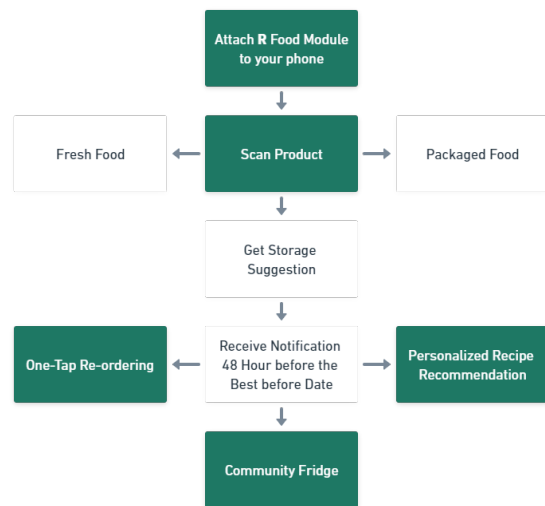
UX/UI application

To watch a demonstration of how our application will work click [here](#).

Solution Architecture

Our product's process flow is described in the figure on the right.

The product can be installed as an iOS/Android application, or it can be bought as a hardware component to be installed in an environment which is to be monitored using an existing IoT ecosystem (also on our app).



The built-in camera scans the product and classifies it according to type and freshness. This data is then sent to a cloud database storage, which is partitioned uniquely for each user as they create an account for our service.

The value addition in our solution is provided through frequent notifications regarding food expiration reminders, storage suggestions, and recipe recommendations. To this end, a notification is sent to the user's phone 48 hours prior to the 'Best Before' date. There are then 3 core suggestions provided to the user: 1) Re-ordering, 2) Community Fridge, and 3) Personalized Recipe Recommendations

Re-ordering: The integrated solution allows re-ordering with a tap of a button.

Community Fridge: Users are encouraged to utilize the service at a flat subscription fee, and reduce the overall wastage of food.

Personalized Recipe Recommendations: According to previously collected data regarding users' behavior, recipes are recommended to utilize the soon-to-be expired products.

Product Infrastructure:

AI Model:

We employ a pre-trained model, in keeping with SAP's 'Low Code / No Code' motto. This model not only classifies objects into categories but also grades their freshness as a decimal number. Here's the [GitHub](#) repository for our model, trained on *VGGNet* and *Kaggle* datasets. We quantize the model using [TensorFlow.TFliteConverter](#) functions in order to reduce its size, and then download it into the *ESP32 Expressif Microcontroller*. Of course, the initial tutorial focused on this method was provided in class as SAP Microcontroller Tutorial.

Hardware:

We use 2 primary components in our product: 1) An OCR Reader and 2) A Microcontroller. The OCR reader extracts expiration dates and product names from *packaged food* items, in case the user doesn't have the time to manually input that data. The microcontroller contains our *Core AI Model* to detect and classify fruits/vegetables/unlabelled items.

Software:

We use the following technologies to develop our backend framework, which are then deployed using SAP Technologies, as described in the next section.

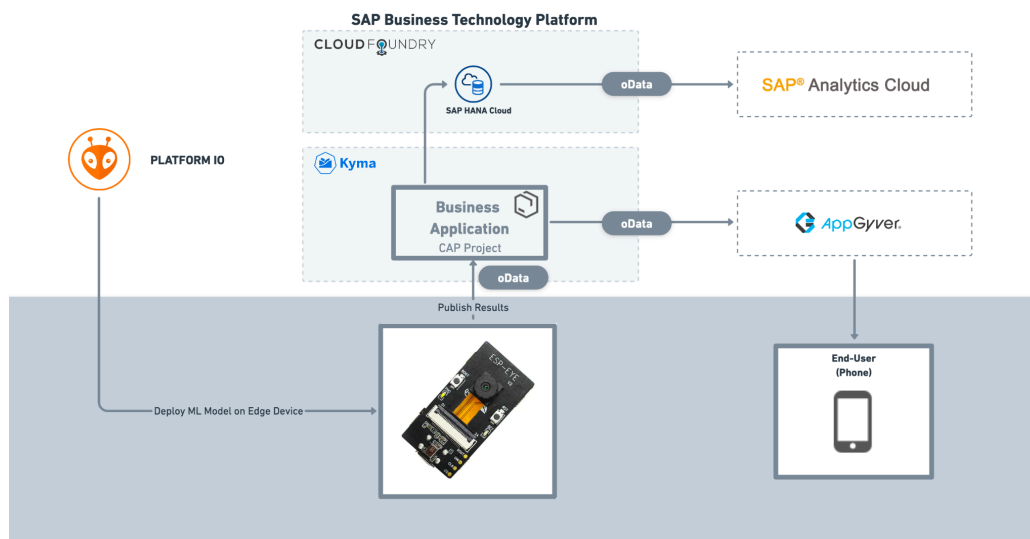
- Frontend: React.js (Desktop), React Native (Android + iOS)
- Backend: Node.js
- Database: SQL

Deployment (Edge Computing):

Our usage of the provided SAP Services, and the process flow, are visualized in the diagram below. Our deployment follows *edge computing practices* since we want to cater our product to

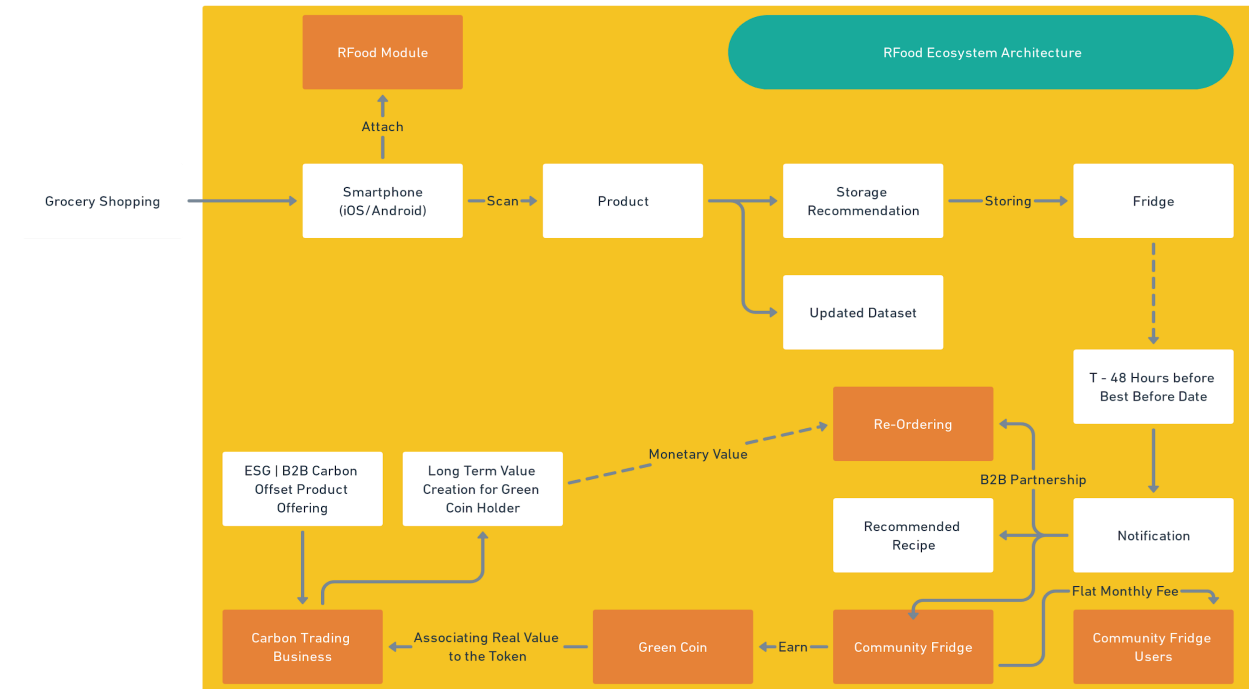
areas with unstable and limited internet connectivity, and we want fast object detection. The deployment shall be described in stages in this section, for the sake of clarity, completeness, and consistency:

1. ESP32/OCR scans the object and obtains some information.
2. Information is sent as an HTTP request to a [CAP Bridge](#) provided by SAP.
3. The CAP Bridge has already been deployed to [SAP BTP Kyma Runtime](#) as a Node.js project using Docker.
4. CAP Bridge converts data to **oDATA** format and displays it directly on the user's screen using SAP [AppGyver](#), and also stores the data in **JSON** format in the SAP [S/4 HANA Cloud](#).
5. The S/4 HANA Database is continuously linked with [SAP Analytics Cloud](#), in order to extract and infer users' behavioural patterns, not only for improving the core service but also for helping eliminate the middle-man from the supply chain and help the manufacturer understand his product's demand.
6. SAP AppGyver provides an interface for the user's phone, where the user can navigate through our intuitive [UX/UI](#) and make the most of the service.



R Growth

Any idea can be extended in multiple ways. The figure below represents our architecture with the inclusion of prospects.



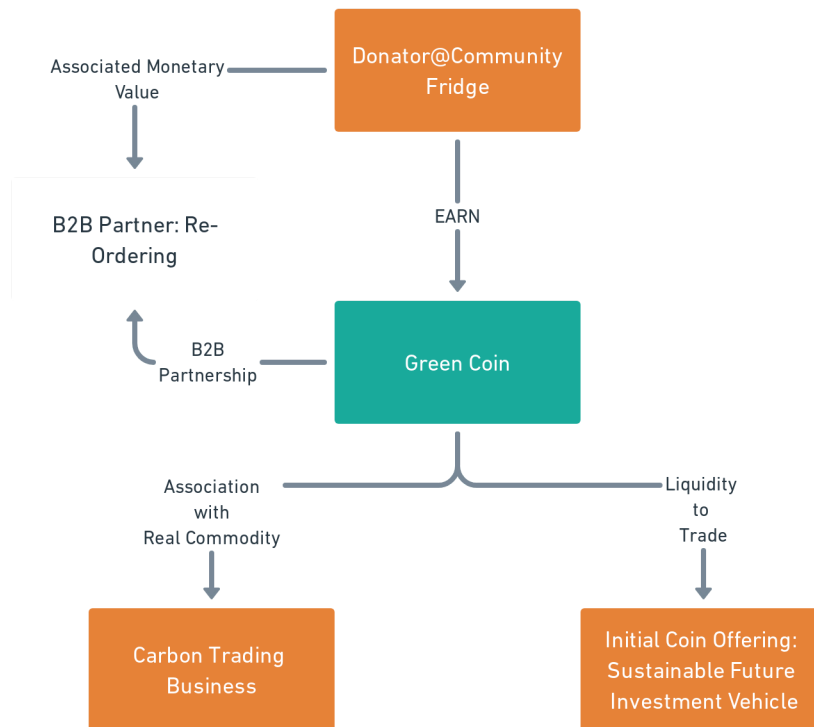
Understanding the flow of ideas in the figure above can be difficult. Therefore, the following is a simplified version of how R food expects to shape its growth. The potential extensions of our product will include the community fridge and the green coin which will help refine our business model. We will also look into the possibility of supply chain integration as our product is capable of facilitating such an endeavour.

The Community Fridge

So we plan to extend our AI model to fridges as well, where we will scan the foods regularly for the expiration date and report live data to the client's smart devices. It will report the warning message, a reorder button, a disposition button, and suggestions for potential recipes depending on the available products in the consumer's fridge. But what is a "community fridge"? This is a fridge for your community, e.g. 1 fridge per KAIST. An individual can place the items that are

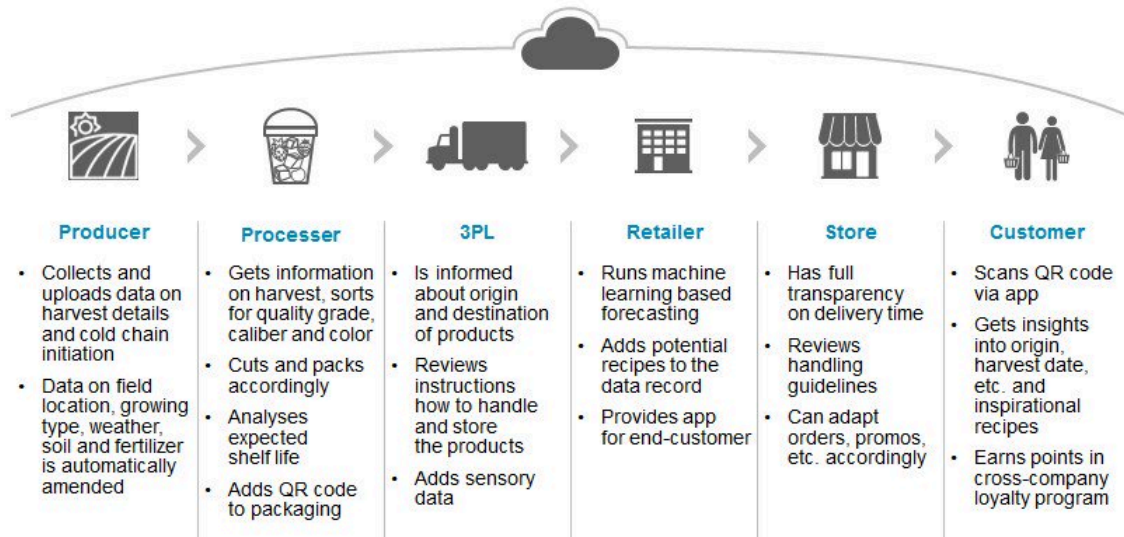
about to expire, and they do not need, in such a fridge for the community to consume and earn green coins.

The Green coin



The figure above simplifies how the green coin gains its value and how it is linked to the community fridge. The green coin is a way we reward our customers for their contribution to the community fridge. It is a token of responsibility and investment towards a sustainable future. How? It is a blockchain-based token which will be associated with our Carbon Trading Business. With this business, we will be helping firms to offset their carbon emissions. Moreover, in order to provide liquidity for our users we will be pursuing an Initial Coin Offering in the future. Lastly, as an immediate reward, we would be negotiating with our B2B re-ordering partner, such as Coupang, to allow some conversion of Green Coin as a discount towards consumer purchases. In return, we will be helping such companies align themselves with the ESG trend.

Possibility of Supply chain integration



The figure above shows a typical supply chain. Fine consumption data of the consumers and better technology make it easier to assess consumer behaviour and do multiple jobs. Therefore, the supply chain can be integrated. We intend to pull this off by supplying the farmers with our proposed solution (which is very simple to use). This will essentially eliminate the need for every middleman between the producer and the customer. Farmers now will be able to categorize the produce themselves with an accurate prediction of the fruit/vegetable's life. Eventually, we aim to create a platform where farmers can instantly post their harvest with the date of expiry, allowing for a delivery system of farm fresh products.

Since we have recognized the possibilities of growth in R food, we can now derive a consistent and sustainable business model.

R Business model

Any vision needs to be backed by a sustainable business model, as that acts as a firmer measure towards aligning required stakeholders towards creating a new market. At R Food, we are looking at five business models that helps us to be aligned across the value of chain and target the climate change

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- Product
 - Margin on the Hardware Product Sale (R Food Module)
 - Monthly Recurring Revenue from the Platform Subscription fee from our Users (\$10-5)
 - Community Fridge
 - Flat Monthly Fee for accessing the community fridges (\$10-15)
 - B2B Sales
 - Margin Fee from the Partnered Online Grocery Service Provider
 - Carbon Credit Trading
 - Helping firms to offset their carbon emission by trading our carbon offset
 - The trading to be done with Green Coin, which will help our users realize real value with our product offering
 - B2B Hospitality Industry
 - Expanding our offering of technology and product towards the hospitality industry (Restaurant, Cafe, etc.)

R Go-to-Market Strategy

Our key objecting in defining our go-to-market strategy are:

1. Balancing Platform Utilization: Users vs Community Fridge Users
2. Operational Efficiency for Community Fridges: Managing Operations of Community Fridges Effectively
3. Efficient Marketing: Penetrating the B2C target Market effectively
4. District wise Operation Integration: Aiming towards synergetic integration of operations in expansion

Based upon population density and overall population our targeted market is 양천구, 송파구.

Furthermore, we will be utilizing the Seoul Big Data platform in creating an environment to train our Reinforcement Learning model in optimizing the location of our community fridges.

Furthermore, with the advent of operation we will be able to refine to reach an optimal go-to-market strategy as we expand our services.



일반행정

[활용사례\(갤러리\) 등록](#)

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스마트서울 도시데이터 센서(S-DoT) 유동인구 측정 정보

서울시 전역에 설치한 스마트서울 도시데이터 센서(S-DoT)를 통해 측정된 유동인구 정보(10분 단위)입니다.
※ 패킷속성정보[송신서버 32, 데이터 1]

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