WASTE MANAGEMENT SYSTEM FOR REDUCING THE WASTE IN MESS IN COLLEGES/OFFICES

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Abstract

In this report, I have proposed the idea of cloud-based solution for owners of food mess in colleges/offices to save money and reduce waste by developing a scanner that categorizes menus, tracks inventory, and uses machine learning algorithms to predict future food consumption. More specifically, it uses a recurrent neural network that inputs past sales to predict future sales. After forecasting future sales, we suggest the quantity of each ingredient that the staff should order in the next few days.

1. Problem statement

The problem statement is to apply the computer vision algorithm to analyse the food quantity cooked in food mess in colleges and offices through scanning of images. Since food wastage is a major problem faced by the world today and it's a need of hour to solve this problem. In order to do so I hope to create a service that can keep a record of the quantity of food prepared, wasted and left and provide insights to the mess owners the quantity they need to prepare in future as per the eating pattern of people.

2. Market/Customer/Business need Assessment

Food waste is a systemic problem that happens along every step of the food supply chain, from farm and field to fork which has resulted in significant and drastic decrease in profit as there's a lot spending on raw ingredients and making of food but comparatively less in saving profit. So, I offer to give the visibility into food waste to empower mess owners and other foodservice providers to make data-informed decisions about their food supply chain workflows**,** in order to **save money — and the environment.**

3. Target Specification

Creating a system that would make a difference in waste management and provide a better solution on analysing food to be prepared on the specific days of week by developing a robust solution that automatically recognizes food throughout all the steps like preparation, cooking, and consumption process based on eating pattern of people.
Restaurants, hotels, and cafes have access to readily available insights into which foods they are wasting most often but if we look at small-scale business-like food mess of any college or office, that line of work is not well engaged with AI and newest technology as they work on pure guess and mind calculation so the amount of waste is at a higher level. This system will be allowing them to better manage their budgets and waste levels. With this reduction of food waste comes significant cost savings and a measurable impact on the environment.

4. External Search

The sources I have used as reference for analysing the need of such a system for local
businesses and how E-commerce giants have been using the technique to boost up online
sales, have mentioned below:

- https://info.winnowsolutions.com/food-waste-management
- https://www.analyticsvidhya.com/blog/2020/02/learn-image-classification-cnn-convolutional-neural-networks-3-datasets/
- https://www.futurebridge.com/artificial-intelligence-to-manage-food-waste/

4.1 Benchmarking

Huge companies like IKEA use food management system on a big scale. Smart scales" are being used to measure the food thrown away in IKEA's direct operations at restaurants (in the kitchens), bistros, and Swedish Food Markets. Co-workers use the scale to weigh the food waste, categorize it, and identify the reason behind the waste

4.2 Applicable Patents

Existing patents

US2019354844A1

Implementing traditional computer vision algorithm as neural networks.

Abstract

Methods and systems for implementing a traditional computer vision algorithm as a neural network. The method includes: receiving a definition of the traditional computer vision algorithm that identifies a sequence of one or more traditional computer vision algorithm operations; mapping each of the one or more traditional computer vision algorithm operations to a set of one or more neural network primitives that is mathematically equivalent to that traditional computer vision algorithm operation; linking the one or more network primitives mapped to each traditional computer vision algorithm operation according to the sequence to form a neural network representing the traditional computer vision algorithm; and configuring hardware logic capable of implementing a neural network to implement the neural network that represents the traditional computer vision algorithm.

Other required patents

US2018018535A1

Visual recognition using deep learning attributes

Abstract

A processing device for performing visual recognition using deep learning attributes and method for performing the same are described. In one embodiment, a processing device comprises: an interface to receive an input image; and a recognition unit coupled to the interface and operable to perform visual object recognition on the input image, where the recognition unit has an extractor to extract region proposals from the input image, a convolutional neural network (CNN) to compute features for each extracted region proposal, the CNN being operable to create a soft-max layer output, a cross region pooling unit operable to perform pooling of the soft-max layer output to create a set of attributes of the input image, and an image classifier operable to perform image classification based on the attributes of the input image.

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4.3 Applicable Constraints

- to identify these different foods in all their potential shapes and sizes, and from a variety of angles.
- second is to analyse and aggregate that data so businesses can begin limiting food waste in real-time.
- Convincing the owners to implement the system in their food mess
- Time consuming at the initial process

4.4 Applicable regulations

- Regulations against false advertising
- Data protection and privacy regulations (Customers)
- Government regulations for disposal of waste

5. Business Opportunity

Small scale businesses usually lack the usage of Artificial Intelligence and newest technology in the market and major factors are shortfall of availability of resources and high costs of the gadgets but by implementing this system it can save time and money by automating and streamlining routine processes and tasks and can improve productivity and operational effectiveness. It will construct faster business decisions based on the results of cognitive technology. If it will be used widely, not only it will help in saving time and money but also the environment as food waste produces a huge amount of greenhouse gases, impacts our land, our water, our biodiversity, and our livelihood in general.

6. Concept Generation

Data Analysis on the basis of Mess Menu: -

VEG MESS MENU OCT-NOV 2019				
DAYS	BREAKFAST	LUNCH	SNACKS	DINNER
MONDAY	IDLY,VADA,PAV BHAJI, SAMBHAR, PEANUT CHUTNEY, TCM, TOASTED BREAD,BUTTER JAM	PHULKA,DAL MAKHANI, BLACK CHANA, POTATO CHIPS,PAPPU KOORA,SAMBHAR, CABBAGE FRY, RASAM,TOMATO RICE, WHITE RICE,PICKLE,PAPAD,SALAD,CURD	SAMBHAR VADA (2 BIG SIZE) TCM	PHULKA,DAL TADKA,TOMATO PAPPU,NICE DOSA,SAMBHAR,PEANUT CHUTNEY,MUSHROOM MUTTER MASALA(EQUAL QUANTITY),ALOO(PEALED) ONION GRAVY,WHITE RICE,CURD,MILK GREEN BIG BANANA, GAJAR KA HALWA
TUESDAY	PURI,CHOLE MASALA,TCM, TOASTED BREAD,BUTTER, JAM(BBJ)	PHULKA,VEG PULAO,DAL PALAK,ALOO GOBI FRY,SOYA CHOP(MEAL MAKER),SAMBHAR,BEETROOT PORIYAL, RASAM,WHITE RICE,MANGO PICKLE,FRYUMS,SALAD,CURD,LEMON JUICE	MUTTER KACHORI , GREEN CHUTNEY, MASALA TEA, COLD COFFEE,MILK	GHEE PHULKA,CHANA DAL,SAMBHAR, KADHAI PANEER,WHITE RICE,CURD,PICKLE, PAPAYA,JALEBI (Thin),MILK
WEDNESDAY	PANEER PARATHA,TOMATO CHUTNEY,CURD,SAMBHAR, CHUTNEY,IDLY,TCM,BBJ	PHULKA,DAL MAKHANI, VEG BIRYANI, GATTE KI SABZI,PAPPU KOORA,SAMBHAR, MIXED VEG PORIYAL/BEANS PORIYAL, RASAM,BUTTER MILK,WHITE RICE,PICKLE,PAPAD,SALAD,CURD	FRUIT/CHOCOLATE CAKE COFFEE,TEA, COLD BADAM MILK	TOMATO PAPPU,PHULKA,PODI DOSA, VEG JAL FREZIE,ONION PUMPKIN, WHITE RICE,RASAM,MASALA DAL,CURD CHOCOLATE/STRAWBERRY ICECREAM MILK , BANANA,GONGURA CHUTNEY
THURSDAY	PONGAL,SAMBHAR,ALOO PURI ,CHUTNEY,TCM,BBJ	PHULKA,CHOLE GRAVY,ALOO CABBAGE , CARROT PORIYAL,ANDRA SPICY PAPPU, RASAM, WHITE RICE,PICKLE,PLAIN KADI, SALAD,GHEE,CURD,DAL,PODI,LEMON JUICE	VEG BURGER,TMC	KAI KARI MANDHI,DAL FRY, PANEER PASANDA,LACHA PARATHA,PHULKA, PINEAPPLE, MILK,SAMBHAR,WHITE RICE,PICKLE,SALAD
FRIDAY	ALOO PARATHA,CURD, TOMATO CHUTNEY,UPMA, CHUTNEY,TMC,BBJ	PHULKA,RAJMA MASALA,DHAI VADA(1), LEMON RICE,SAMBHAR,PAPPU KOORA, TINDOORA FRY,TOMATO SABZI(JAIN TYPE),RASAM,PAPAD,SALAD,CURD,PICKLE ,LEMON JUICE	VEG PUFF KETCHUP, TMC	PHULKA,BLACK DAL, IDY , CHUTNEY, SAMBHAR,WHITE RICE,RASAM,PICKLE, CURD,WATERMELON,PAKODI KADI, MILK ,GULAB JAMUN
SATURDAY	NICE MASALA DOSA,FRUIT KESARI, PICKLE,MANGALORE BONDA,TMC,BBJ	PHULKA,ALOO MUTTER GRAVY,BISMILLAH BATH,WHITE RICE , WHITE CHANA MASALA, VEG MIXED MASALA,RASAM,PICKLE,BUTTER MILK,PAYASAM,POTATO CHIPS	VEG SAMOSA,IMLY CHUTNEY,TM	PHUKLA,GOBI FRIED RICE,ARABI GRAVY, CHUTNEY,SAMBHAR,WHITE RICE, PICKLE, BUTTER MILK,FRUIT CUSTARD,MILK
SUNDAY	GOBI PARATHA,CURD, TOMATO CHUTNEY,BBJ,TMC	PHULKA,FRENCH FRIES,WHITE RICE, DAL MAHARANI,PICKLE,RASAM,CURD,FRYUMS, GOBI MUNCHURIAN DRY,BOONDI RAITA,SALAD,PANEER BHURJI,TAMARIND RICE,CURD,PAYASAM,MINT MOJITO	TOASTED VED SANDWICH (STUFFED PROPERLY),KETCHUP,TMC	PHULKA,DAL LASSONI,JEERA RICE,YAM FRY ALOO GOBI,CAPICUM MASALA,LADOO, WHITE RICE,SAMBHAR,RASAM,CHOCOLATE MILK,BIG GREEN BANANA,SALAD

Let’s take an example from the given mess menu, if it’s Sunday and the built system detects that the most wasted item on the list is rice based on the prediction analysis and eating pattern of people. The system then tells the information of quantity of food produced, quantity of food wasted and most wasted item on the list of that day. It will keep a record of the production and wastage on daily basis and will let you know the amount of ingredients to be used in coming days.

7. Concept Development

The final product is a service that provides small businesses with detailed information on amount of wastage of food, insights into which foods they are wasting most often, quantity of ingredients to be used in future and everything through scanning the images (served in plates) and analysing eating pattern of people on weekly basis using machine learning algorithms.

Concepts to be used in the System

Computer Vision Algorithm

In the world of advancement of technology and Artificial intelligence, computer vision algorithm provides a hand in processing complex data within a span of a second.

computer vision algorithms would accurately recognize the number of ingredients — vegetables, fruits, bread, rice, dal, sabzi, curd etc and will display an output based on the menu (entered in the model).

algorithms needed to be able to identify these different foods in all their potential shapes and sizes, and from a variety of angles. For example, a tomato might appear on a plate cubed, sliced, halved, quartered, whole, as well as cooked or fresh. With all these variables, resulting datasets are necessarily massive.

Convolutional Neural Network

CNN presents tremendous progress in image recognition

Artificial Neural Networks are used in various classification tasks like image, audio, words. Different types of Neural Networks are used for different purposes, for example for predicting the sequence of words we use Recurrent Neural Networks more precisely an LSTM, similarly for image classification we use Convolution Neural networks.

Our dataset will consist of labelled images, meaning each image will be having a corresponding labelled image which indicates the correct prediction for the input image.

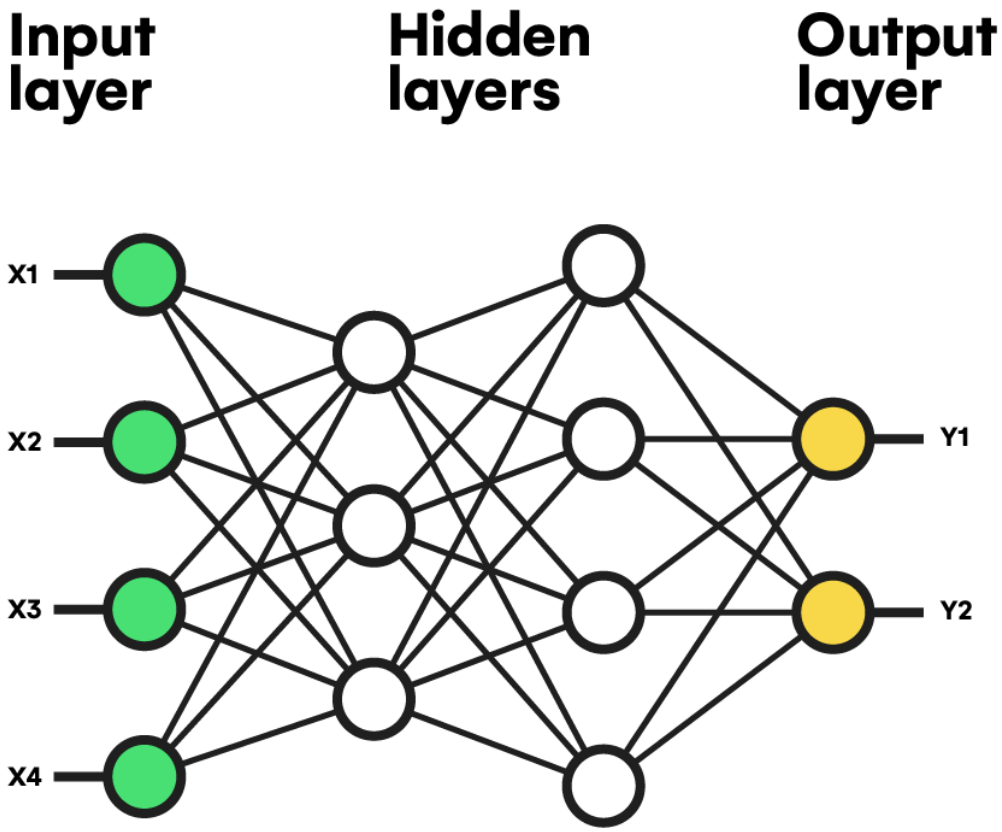
The main reason behind using **Convolutional Network that the image has the** potential to pull out certain features or patterns from pictures which have the capability of unchanging its position, rotation and scale. To acknowledge more about the power of these properties when detecting features in images, let's consider an example.

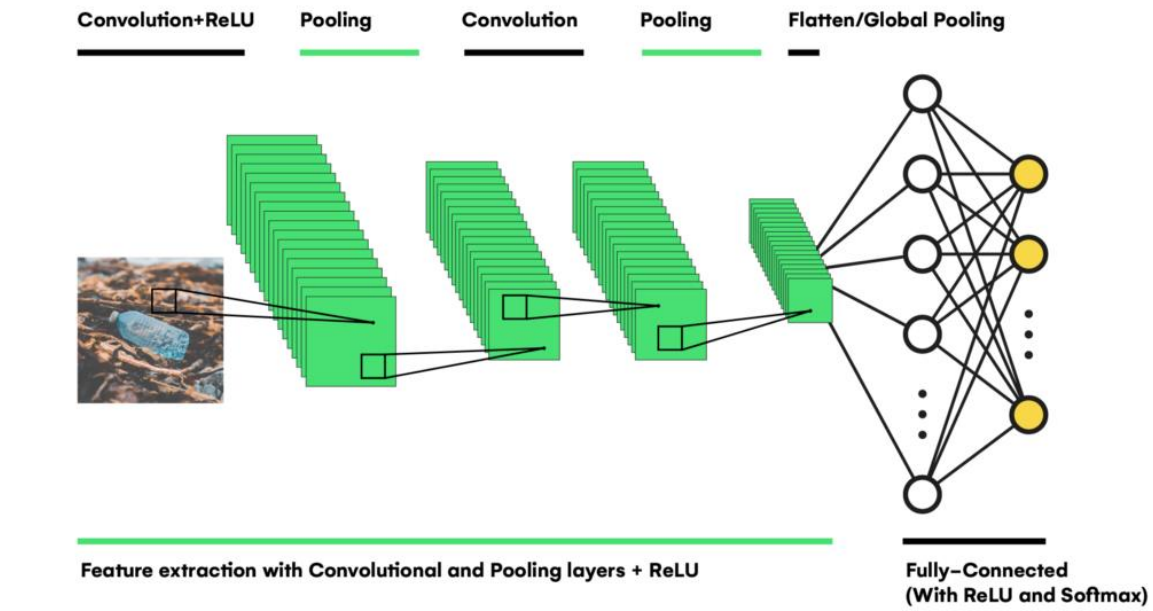
Image 1

Image 2

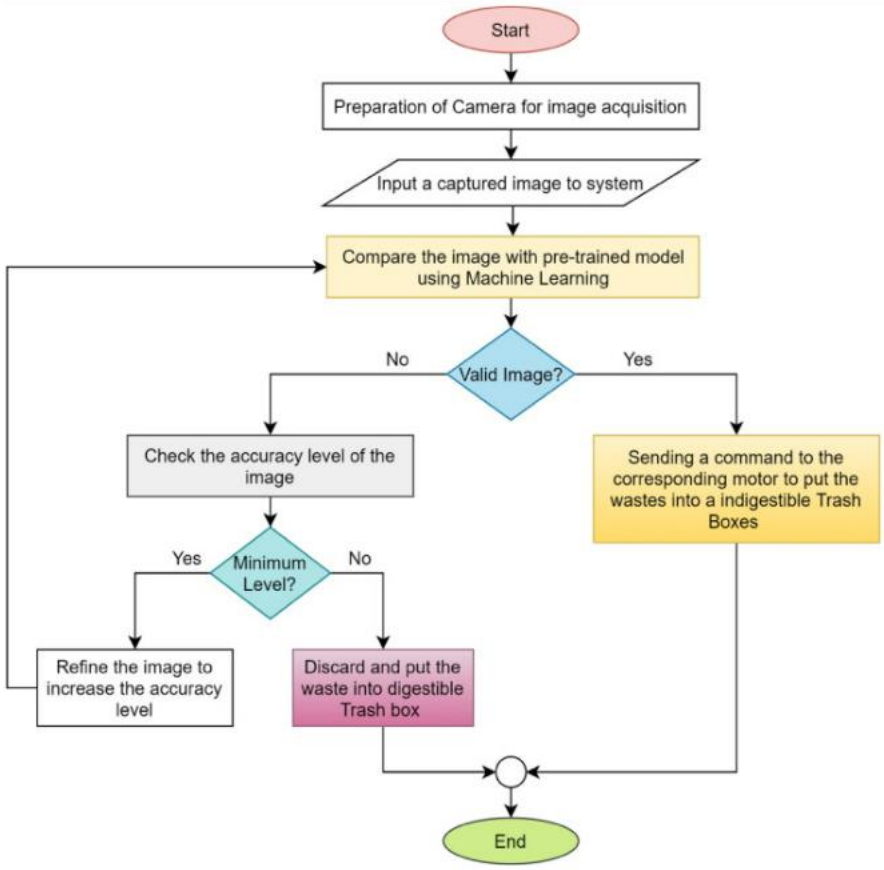
It will identify these different foods in all their potential shapes and sizes, and from a variety of angles.

CNN works on the following principle.

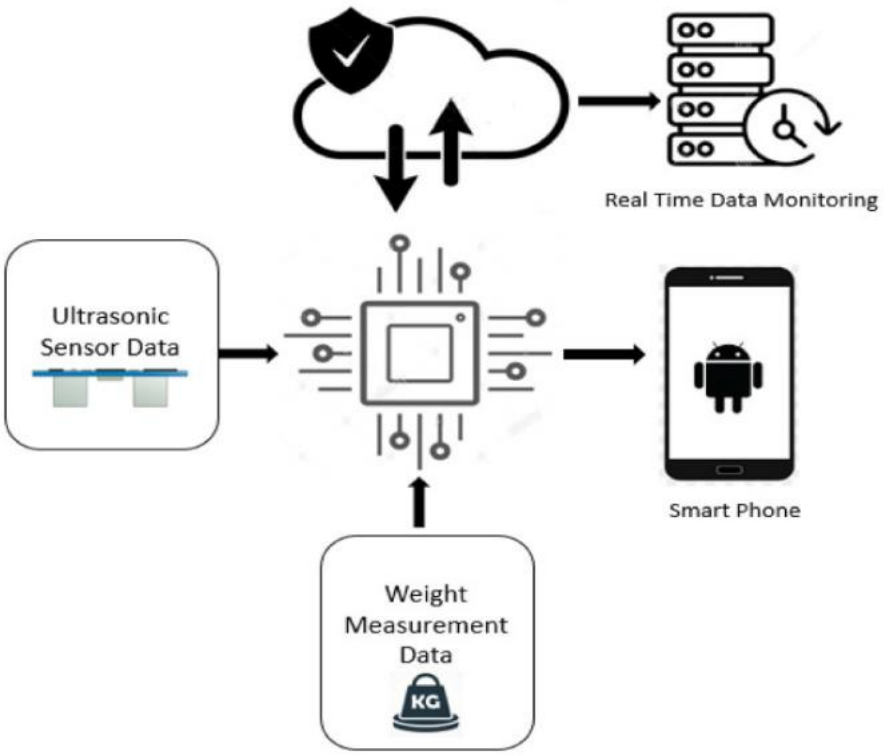




First, the input image is passed through a series of convolutional layers, and then multiple beads with different values are used in each layer to extract features of increasing complexity. Then, by merging the convolutional layers and reducing the dimensions of the image, some clustering layers are wrapped with specific changes, such as average, maximum or minimum elements, instead of the classic weighted sum. These actions also help preserve information on the network. After extracting, features, the Flatten or Global Pooling layer transforms the output of the last convolutional layer and provides a fully connected (dense) network that performs classification based on the learned patterns. The last layer of the entire network contains a number of neurons equal to the number of predictable classes. Using the softmax activation function, the layer can assign a probability to each neuron that represents the number of times a feature class occurs in the input image.



This flowchart will treat as an example how things will be taken place at the back of the system implementation.



The above given diagram is a brief representation of how food will be detected and the weight measurement data will be directed to the smart phone or desktop for user understanding

8. Final product prototype

The device is simple to use:

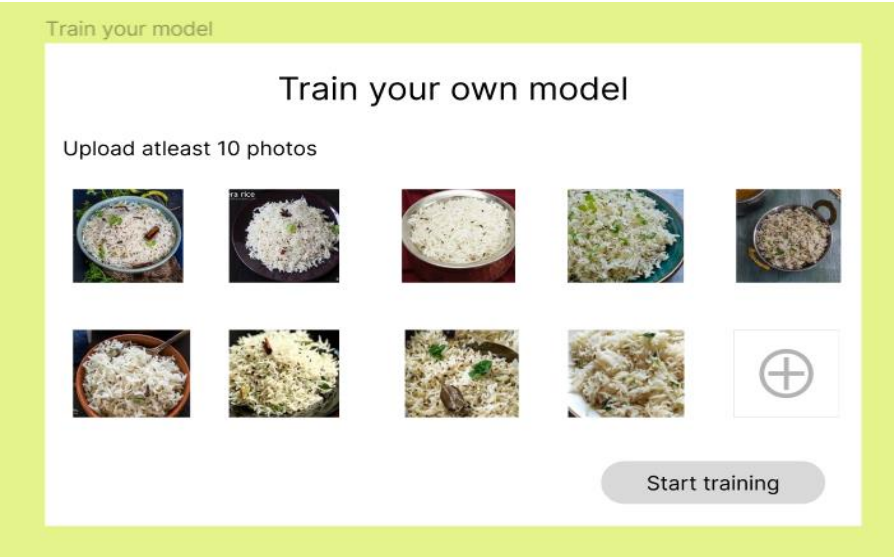
Before when the staff person disposes the food, hold it in front of the scanner and with the help of computer vision algorithm, it takes a picture and then processes the input data and categorizes the food on the plate to be aggregated and presented on a personalized dashboard.

Front end

Step 1

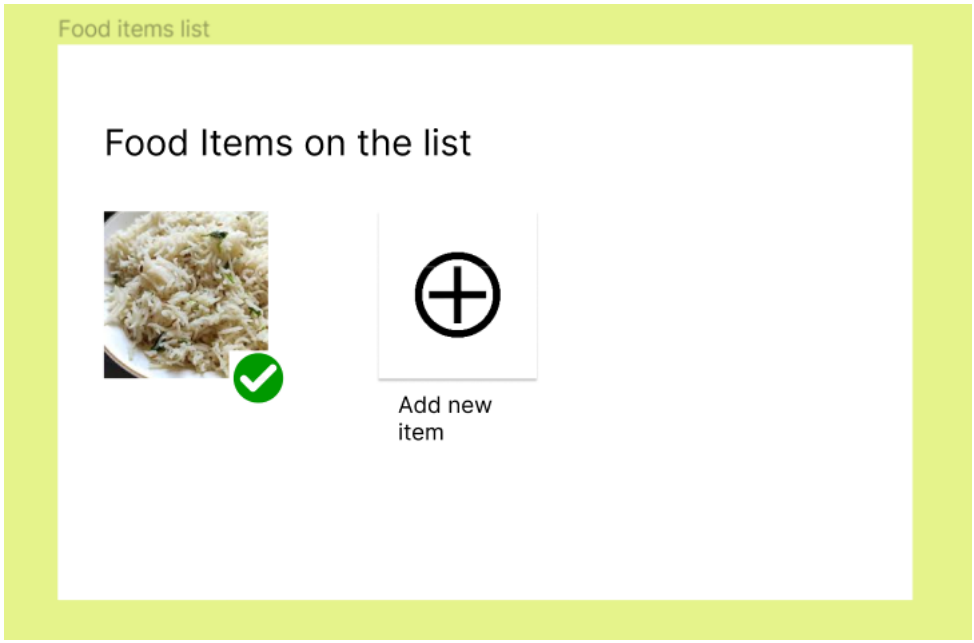
First the owners have to train their model as that could accurately recognize food of all shapes in sizes, and at every stage of the cooking process.

This could be done by giving atleast 10 images of the food listed on your menu on daily basis in different forms so that model gradually gets trained and gives the best result by recognizing image in every angle and view.



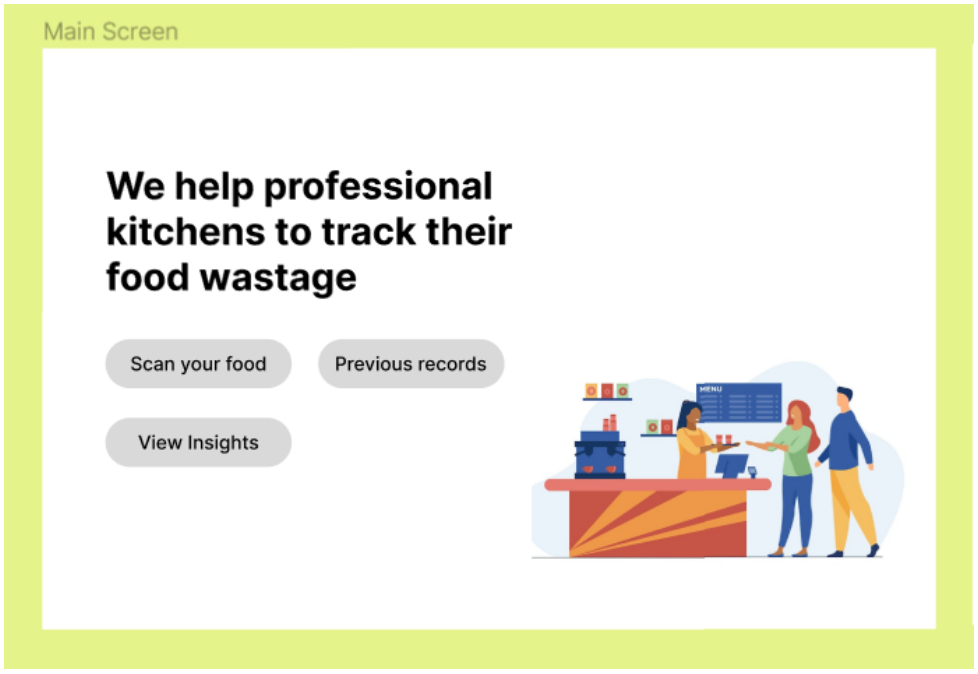
Step 2

Now the recognized image will be listed in the food items list and user will be given an option to add a new food item by clicking on “add new items” and it will again lead to scanning and training process.



Step 3

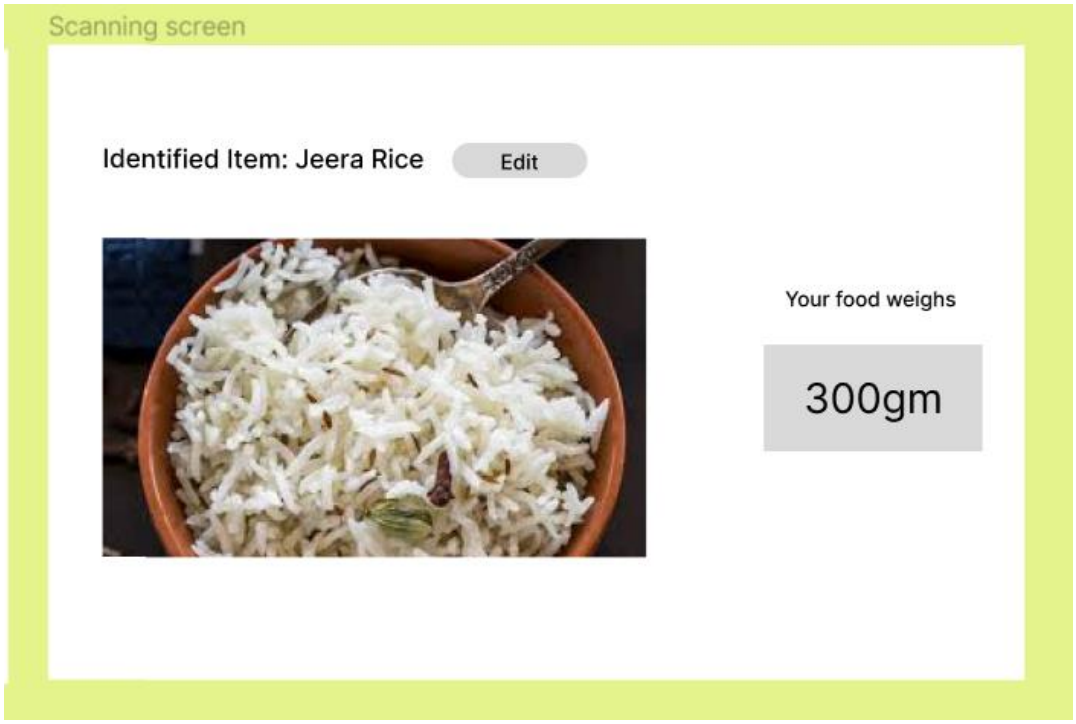
Now that the model is trained, it will now be implemented for daily purpose.



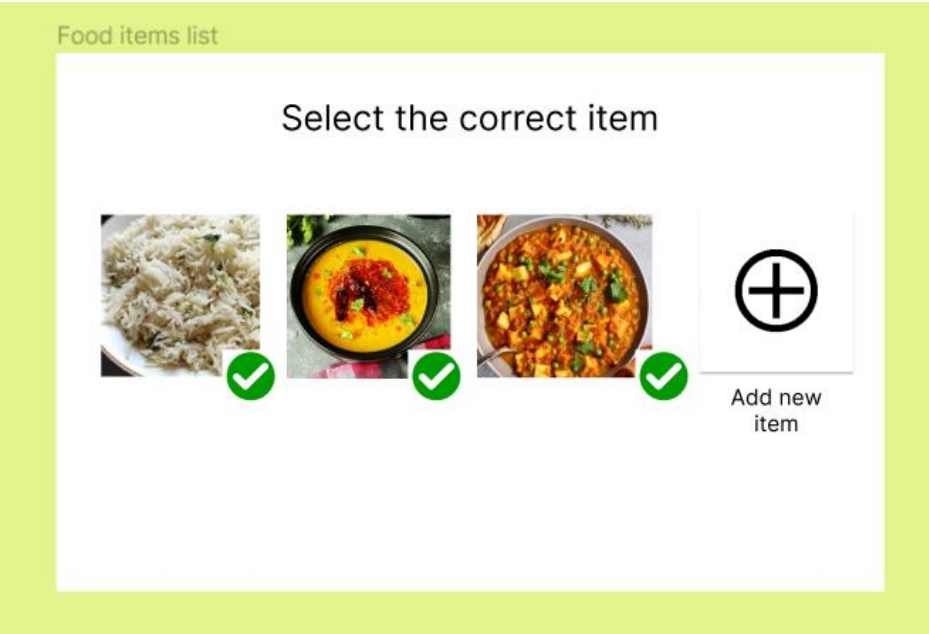
The above screen is the main screen that will be displayed for the user to interact.

Screen consists of following buttons: “Scan your food”, “previous records” and “view insights”.

Scan your food: will let you scan the food on your plate before disposal and will detect the scanned image as what food item is identified and the amount of wastage your plate contains.



If the predicted image does not match with the food that is scanned then the user can simply click on “edit” and it will provide the list of the menu and the user can then select the food item to be chosen.



Previous records: will take you to another screen where you can a detailed view of amount of food production, amount of wastage and most wasted food.

View insights: will brief the owner/staff about most wasted food item and the production of food item on a week day and lets you know the preferred quantity of food to be made in the next coming days.

Link for the prototype:

https://www.figma.com/file/YMEQvTVdXeKGD6eTpTVnX3/Untitled?node-id=1%3A2

Conclusion

The implementation of AI and ML in food manufacturing and college/office mess businesses is already moving the industry to a new level, enabling fewer human errors and less waste of abundant products; lowering costs for storage/delivery and transportation; and creating happier customers and the above mentioned system is an example of implementing AI in small businesses that will provide access to readily available insights into which foods they are wasting most often, allowing them to better manage their budgets and waste levels and will also be small contribution in saving the environment.