PROJECT REPORT

AI-POWERED NUTRITION ANALYZER FOR FITNESS ENTHUSIASTS

Team ID : PNT2022TMID35778

TEAM MEMBERS

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INTRODUCTION

Nutrition analysis is the process of determining the nutritional content of food. It is a vital part of analytical chemistry that provides information about the chemical composition, processing, quality control and contamination of food. Food is essential for human life and has been the concern of many healthcare conventions.

Nowadays new dietary assessment and nutrition analysis tools enable more opportunities to help people understand their daily eating habits, exploring nutrition patterns and maintain a healthy diet. A fruit dataset describes variety of fruit images apple, banana, orange, pineapple, watermelon. The fruit nutrition is done by analysis. The analysis can be done using convolution neural network. It has four layers as convolution layer, pooling layer, flattening layer and fully connected layer.

1. **Project Overview**

   Different types of fruits are analyzed based on their images which are captured for classification . The analysis is done based on different characteristics like colour , shape, texture etc so as to provide a deep intellect about the nutritional characterization and benefits present in them. This model helps fitness enthusiasts and health conscious people in their journey to better understand their food and hygiene habits so as to hold a healthier life.

2. **Purpose**

   The main purpose of the project is to build a model which is used for classifying the fruit depending on the different characteristics like colour, shape, texture etc. Here the user can capture the images of different fruits and then the image will be sent to the trained model. The model analyses the image and detects the nutrition based on the fruits like (Sugar, Fibre, Protein, Calories, etc.)

LITERATURE SURVEY

S.NO	AUTHOR	TITLE	OBJECTIVE
1.	Praveen Chopra et al. (2022)	ProgressiveSpinal Net architecture for FC layers	In this paper the Progressive SpinalNet progressive computational network for FC layers of deep- networks is introduced as an upgraded version of the DNN concept.
2.	H M Dipu Kabir et al. (2022)	SpinalNet: Deep Neural Network with Gradual Input [2]	In this research, the SpinalNet DNN model was introduced. The chordate nervous system, which has a special way of connecting a lot of sensing data and making local decisions, is mimicked in the construction of Spinal Net.

3.	Mirra K B	Classification of Fruits Using Deep Learning Algorithms [3]	In this study a deep learning-based system for classifying fruits is suggested. A DCNN model, an AlexNet model, and a MobileNetV2 model were investigated in the proposed framework. Three datasets with different sizes and levels of complexity were used to test the recommended framework.
4.	Feras Albardi et al (2021)	A Comprehensive Study on Torchvision Pre-trained Models for Fine-grained Inter-species Classification	This study attempts to investigate various pre-trained models provided in the PyTorch library's Torchvision package. And look into how well they can classify fine- grained photos.

5.	Nguyen Vuong Thinh et al (2021)	Fruits classification by using machine learning - An experiment using popular approaches on local data	In this paper, we examine the methods for classifying images that can be used to categorise fruits. The study's findings can be used to place fruit on the correct shop shelves, spot fruit mismatches there, or check fruit prices without using a barcode scanner. Three well-known classification models—Random Forest, K-Nearest Neighbors (KNN), and Support Vector Machine—are employed in this study (SVM).

6.	Haci Bayram Ünal et al. (2021)	Fruit Recognition and Classification with Deep Learning Support on Embedded System (fruitnet)	This suggested study employs image processing techniques for fruit recognition. Convolutional Neural Networks (ConNN)* deep learning model for classification is created in the study. The Keras platform was used to construct the suggested model.
7.	Marieke van Erp et al. (2021)	Using Natural Language Processing and Artificial Intelligence to Explore the Nutrition and Sustainability of Recipes and Food	According to this paper's point of view, Interdisciplinary approaches should be used to address food and recipe research in order to address health and sustainability issues. These approaches should combine NLP and other AI techniques with

			historical food research, food science, nutrition, and sustainability expertise.
8.	Mehenag Khatun et al. (2020)	Fruits Classification using Convolutional NeuralNetwork	This study investigates a CNN-based classification of fruits. For five scenarios utilising the fruits-360 dataset, the accuracy and loss curves were created using various combinations of hidden layers. This paper discusses several computer vision-based approaches and algorithms for fruit recognition and classification.
9.	Siyuan Lu et al. (2016)	Fruit classification by HPA-SLFN	In this study, we introduced a brand-new fruit classification method called HPA-SLFN. The findings indicated that HPA-classification SLFN's accuracy of 89.5% was superior to those of other classification

			techniques.
10.	Ghulam Muhammad et al. (2015)	Date fruits classification using texture descriptors and shape-size features [10]	In this study a suggested technique breaks down a visual image of a date into its component colours. The local texture descriptor, such as a Weber local descriptor (WLD) histogram or a local binary pattern (LBP), is then applied to each component in order to encode the texture pattern of the date. To characterise the image, the texture patterns fromeach component are combined.

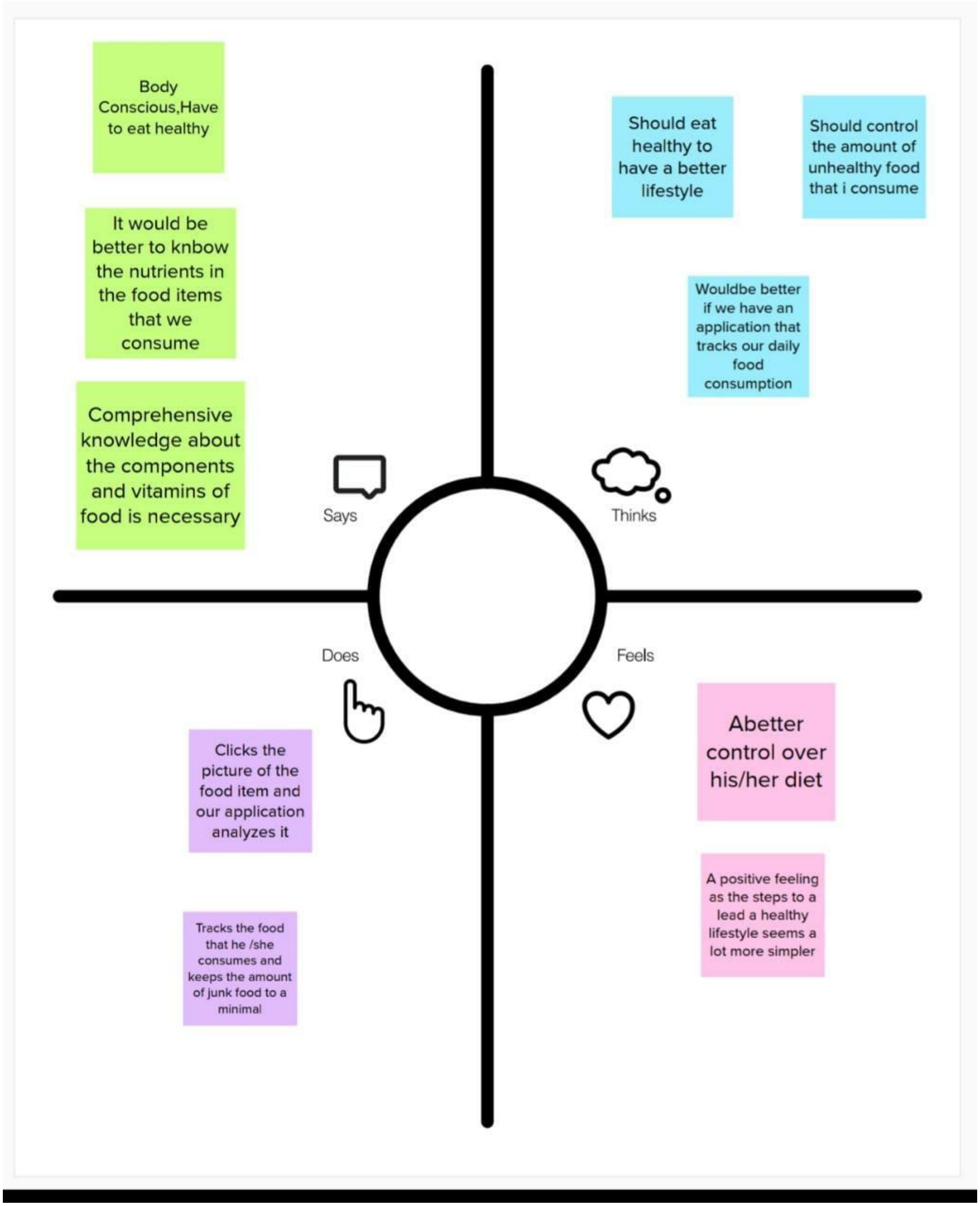
2. references -

1. Muhammad, Ghulam. "Date fruits classification using texture descriptors and shape-size features." Engineering Applications of Artificial Intelligence 37 (2015): 361-367.
2. Lu, Siyuan, et al. "Fruit classification by HPA-SLFN." 2016 8th International Conference on Wireless Communications & Signal Processing (WCSP). IEEE, 2016.
3. Khatun, Mehenag, et al. "Fruits Classification using Convolutional Neural Network." GRD Journals-Global Research and Development Journal for Engineering 5.8 (2020).

4. Ünal, Haci Bayram, et al. "Fruit recognition and classification with deep learning support on embedded system (fruitnet)." 2020 Innovations in Intelligent Systems and Applications Conference (ASYU). IEEE, 2020.
5. Thinh, Nguyen Vuong, et al. "Fruits classification by using machine learning-An experiment using popular approaches on local data." 2021 IEEE International Conference on Machine Learning and Applied Network Technologies (ICMLANT). IEEE, 2021.
6. Albardi, Feras, et al. "A comprehensive study on torchvision pre-trained models for fine-grained inter-species classification." 2021 IEEE International Conference on Systems, Man, and Cybernetics (SMC). IEEE, 2021.
7. KB, Mirra, and R. Rajakumari. "Classification of Fruits Using Deep Learning Algorithms." Available at SSRN 4068366.
8. Chopra, Praveen. "Progressivespinalnet architecture for fc layers." arXiv preprint arXiv:2103.11373 (2021).
9. Kabir, HM Dipu, et al. "Spinalnet: Deep neural network with gradual input." IEEE Transactions on Artificial Intelligence (2022).
10. Van Erp, Marieke, et al. "Using natural language processing and artificial intelligence to explore the nutrition and sustainability of recipes and food." Frontiers in artificial intelligence 3 (2021): 62157

IDEATION & PROPOSED SOLUTION

1. Empathy Map Canvas



Body Conscious,Have to eat healthy

It would be better to knbow the nutrients in the food items that we consume

Comprehensive knowledge about the components and vitamins of food is necessary

Should eat healthy to have a better lifestyle

Should control the amount of unhealthy food that i consume

Wouldbe better if we have an application that tracks our daily food consumption

Clicks the picture of the food item and our application analyzes it

Tracks the food that he /she consumes and keeps the amount of junk food to a minimal

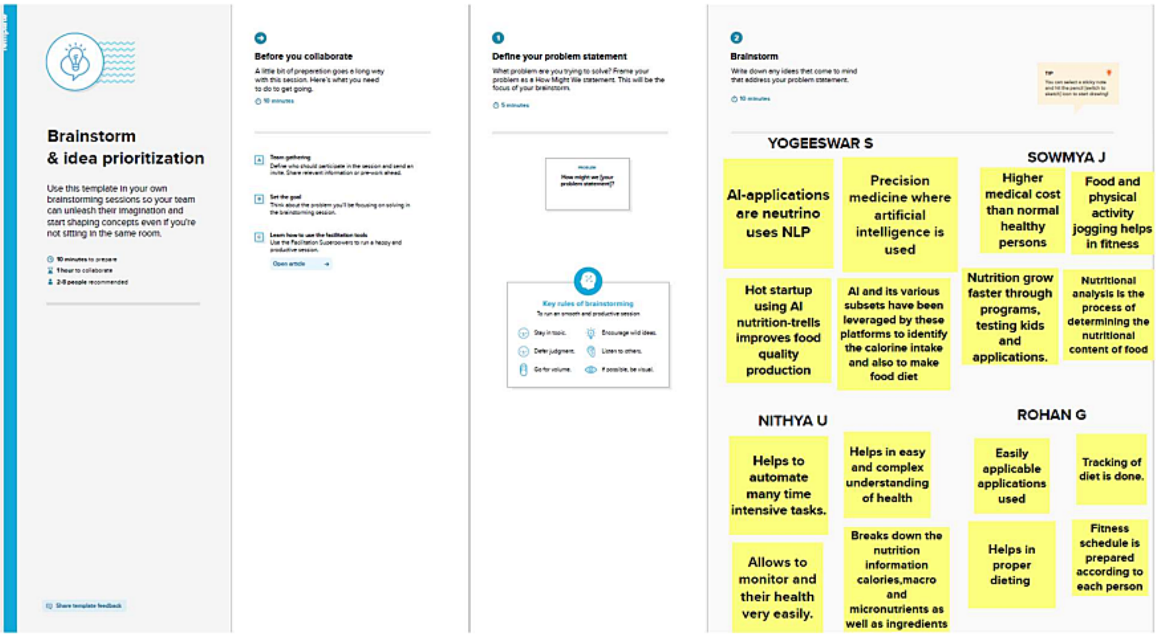
Abetter control over his/her diet

A positive feeling as the steps to a lead a healthy lifestyle seems a lot more simpler

2. **Ideation & Brainstorming**

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions. Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

Step-1: Team Gathering, Collaboration and Select the Problem Statement



Brainstorm
& idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

10 minutes to prepare
1 hour to collaborate
2-8 people recommended

Share template feedback

Before you collaborate

A little bit of preperation goes a long way with this session. Here's what you need to do to get going.

10 minutes

Team gathering
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.

Set the goal
Think about the problem you'll be focusing on solving in the brainstorming session.

Learn how to use the facilitation tools
Use the Facilitation Superpowers to run a happy and productive session.

Open article →

1 Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

PROBLEM
How might we [your problem statement]?

Key rules of brainstorming
To run an smooth and productive session

Stay in topic.
Encourage wild ideas.
Defer judgment.
Listen to others.
Go for volume.
If possible, be visual.

2 Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

TIP
You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!

YOGEESWAR S

AI-applications are neutrino uses NLP

Precision medicine where artificial intelligence is used

Hot startup using AI nutrition-trells improves food quality production

AI and its various subsets have been leveraged by these platforms to identify the calorine intake and also to make food diet

SOWMYA J

Higher medical cost than normal healthy persons

Food and physical activity jogging helps in fitness

Nutrition grow faster through programs, testing kids and applications.

Nutritional analysis is the process of determining the nutritional content of food

NITHYA U

Helps to automate many time intensive tasks.

Helps in easy and complex understanding of health

Allows to monitor and their health very easily.

Breaks down the nutrition information calories,macro and micronutrients as well as ingredients

ROHAN G

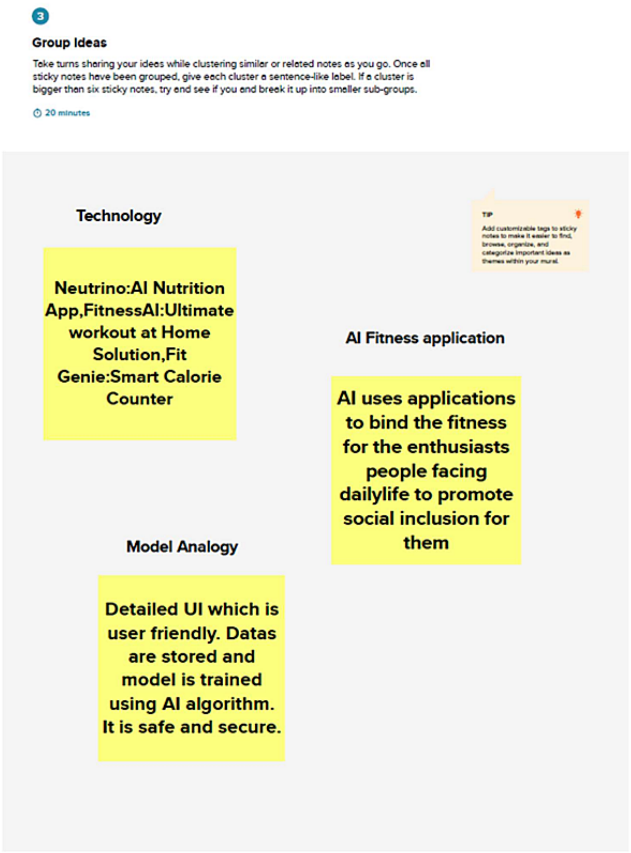
Easily applicable applications used

Tracking of diet is done.

Helps in proper dieting

Fitness schedule is prepared according to each person

Step-2: Brainstorm, Idea Listing and Grouping



3

Group Ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

TIP

Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mural.

Technology

Neutrino:AI Nutrition App,FitnessAI:Ultimate workout at Home Solution,Fit Genie:Smart Calorie Counter

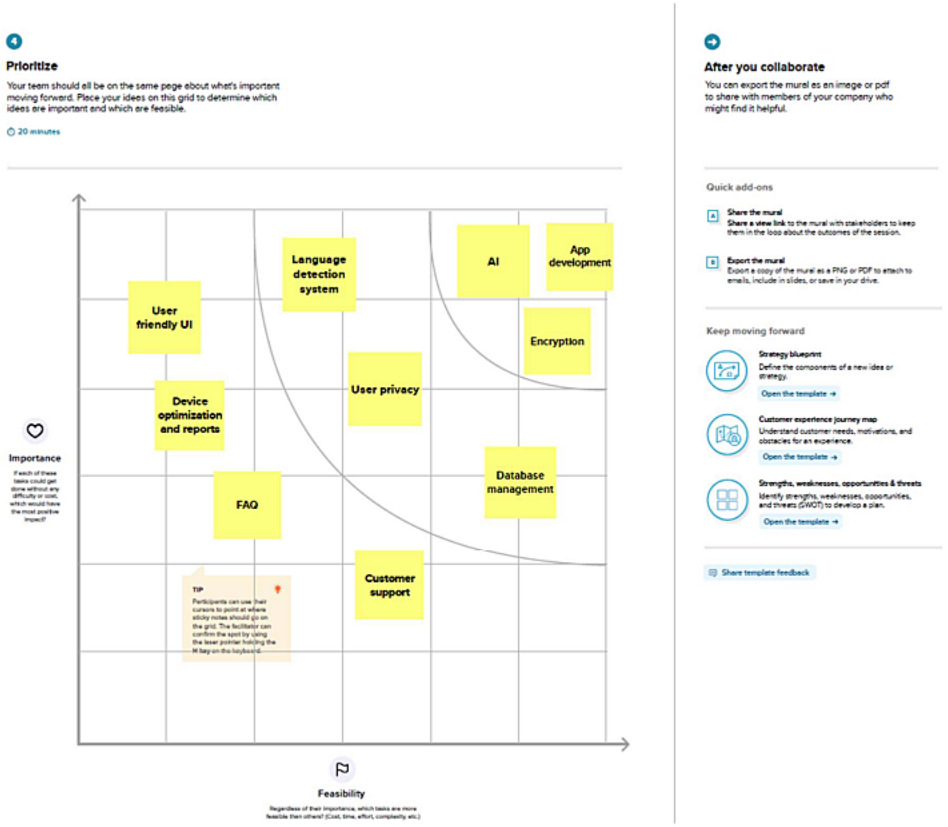
AI Fitness application

AI uses applications to bind the fitness for the enthusiasts people facing dailylife to promote social inclusion for them

Model Analogy

Detailed UI which is user friendly. Datas are stored and model is trained using AI algorithm. It is safe and secure.

Step-3: Idea Prioritization



Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes

Importance

If each of these tasks could get done without any difficulty or cost, which would have the most positive impact?

Feasibility

Regardless of their importance, which tasks are more feasible than others? (Cost, time, effort, complexity, etc.)

TIP

Participants can use their cursors to point at where sticky notes should go on the grid. The facilitator can confirm the spot by using the laser pointer holding the H key on the keyboard.

After you collaborate

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

Quick add-ons

A **Share the mural**
Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.

B **Export the mural**
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

Keep moving forward

Strategy blueprint
Define the components of a new idea or strategy.

Customer experience journey map
Understand customer needs, motivations, and obstacles for an experience.

Strengths, weaknesses, opportunities & threats
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.

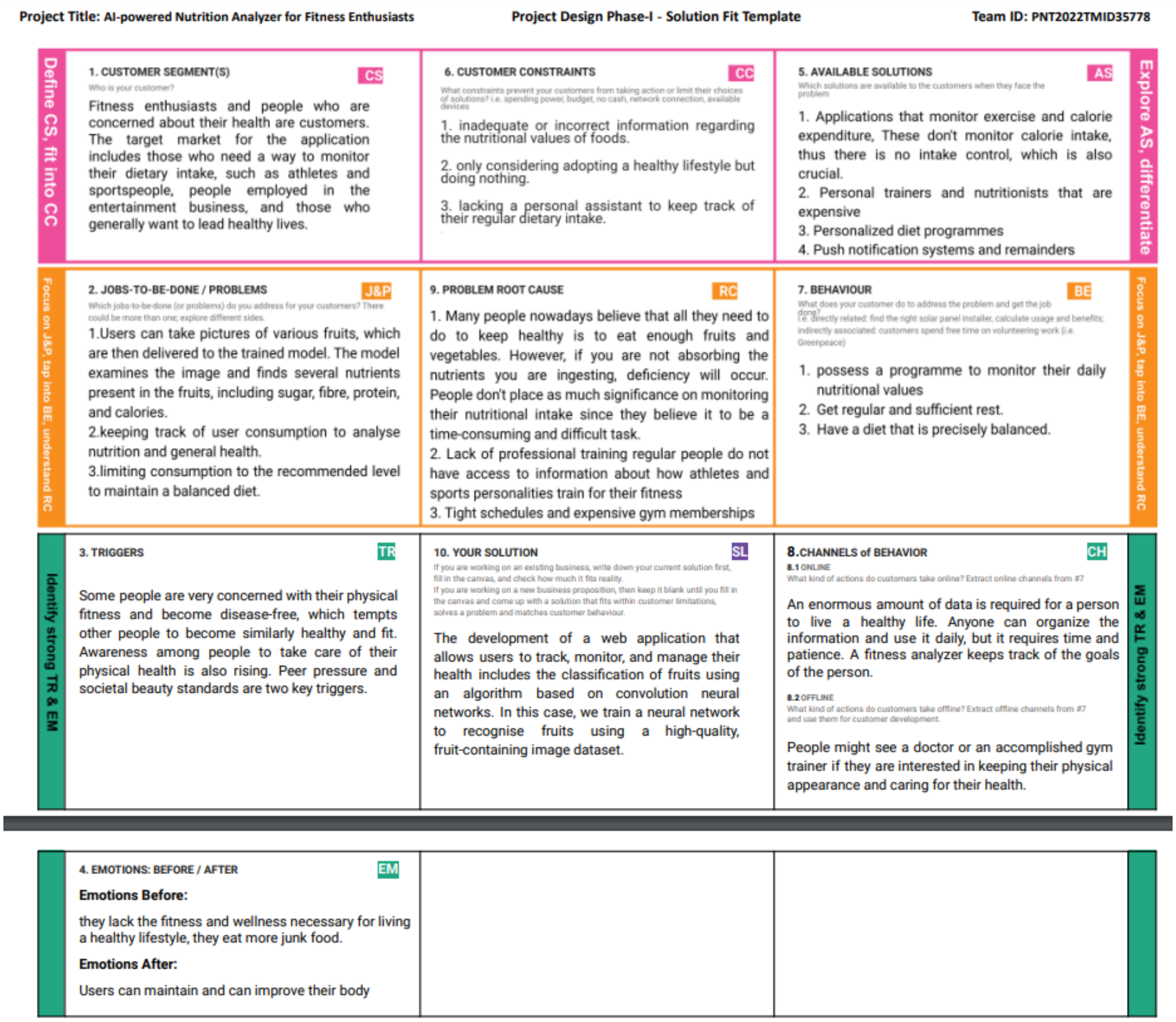
3. Proposed Solution

S.No.	**Parameter**	**Description**
1.	Problem Statement (Problem to be solved)	To develop an AI powered system that identifies edible products and discerns their nutritional information for the benefit of fitness enthusiasts.

2.	Idea / Solution description	The idea is to use convolution neural networks, a type of artificial neural network used in image recognition and processing that is specifically designed to process pixel data, which is used to classify images. Once the row food items have been identified, their corresponding nutritional values are fetched from a database where the relevant details are stored. The application allows for a user to keep track of the amount of calories they consume in a day versus the total recommended amount for their dietary needs.
3.	Novelty / Uniqueness	Nutritional calculator that is straightforward, customizable, and user-friendly. The CNN based fruit classifier that supports nutrition analyser that provides nutrition values of the fruit.
4.	Social Impact / Customer Satisfaction	The proposed application helps fitness enthusiasts monitor their caloric intake and maintain their physical condition with a free programme. This application can help people live healthier lives, regardless of how self-conscious they are about their physical appearance. It keeps track of what users consume, offers recipes and healthy alternatives, as well as fitness schedules.
5.	Business Model (Revenue Model)	Public access to the application is possible after deployment. The software would attract the interest of various people who are motivated to live a healthy lifestyle and desire to change their physical appearance. The programme could be designed so that functions are gradually unlocked based on the membership fee provided by the user, starting from the feature that charts out a user's specific plans to the general nutrition analyzer tool.

6.	Scalability of the Solution	There are various features in the suggested application. It can be improved further to incorporate new features based on user comments and ratings. The nutrition analyzer now only works with fruits, but it can be expanded to work with other foods. using a mobile app.

4. Problem Solution fit



Project Title: AI-powered Nutrition Analyzer for Fitness Enthusiasts

Project Design Phase-I - Solution Fit Template

Team ID: PNT2022TMID35778

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

Who is your customer?

Fitness enthusiasts and people who are concerned about their health are customers. The target market for the application includes those who need a way to monitor their dietary intake, such as athletes and sportspeople, people employed in the entertainment business, and those who generally want to lead healthy lives.

6. CUSTOMER CONSTRAINTS CC

What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices

1. inadequate or incorrect information regarding the nutritional values of foods.

2. only considering adopting a healthy lifestyle but doing nothing.

3. lacking a personal assistant to keep track of their regular dietary intake.

5. AVAILABLE SOLUTIONS AS

Which solutions are available to the customers when they face the problem

1. Applications that monitor exercise and calorie expenditure, These don't monitor calorie intake, thus there is no intake control, which is also crucial.
2. Personal trainers and nutritionists that are expensive
3. Personalized diet programmes
4. Push notification systems and remainders

Explore AS, differentiate

Focus on J&P, tap into BE, understand RC

2. JOBS-TO-BE-DONE / PROBLEMS J&P

Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides.

1.Users can take pictures of various fruits, which are then delivered to the trained model. The model examines the image and finds several nutrients present in the fruits, including sugar, fibre, protein, and calories.
2.keeping track of user consumption to analyse nutrition and general health.
3.limiting consumption to the recommended level to maintain a balanced diet.

9. PROBLEM ROOT CAUSE RC

1. Many people nowadays believe that all they need to do to keep healthy is to eat enough fruits and vegetables. However, if you are not absorbing the nutrients you are ingesting, deficiency will occur. People don't place as much significance on monitoring their nutritional intake since they believe it to be a time-consuming and difficult task.
2. Lack of professional training regular people do not have access to information about how athletes and sports personalities train for their fitness
3. Tight schedules and expensive gym memberships

7. BEHAVIOUR BE

What does your customer do to address the problem and get the job done?
i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace)

1. possess a programme to monitor their daily nutritional values
2. Get regular and sufficient rest.
3. Have a diet that is precisely balanced.

Focus on J&P, tap into BE, understand RC

Identify strong TR & EM

3. TRIGGERS TR

Some people are very concerned with their physical fitness and become disease-free, which tempts other people to become similarly healthy and fit. Awareness among people to take care of their physical health is also rising. Peer pressure and societal beauty standards are two key triggers.

10. YOUR SOLUTION SL

If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality.
If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.

The development of a web application that allows users to track, monitor, and manage their health includes the classification of fruits using an algorithm based on convolution neural networks. In this case, we train a neural network to recognise fruits using a high-quality, fruit-containing image dataset.

8.CHANNELS of BEHAVIOR CH

8.1 ONLINE

What kind of actions do customers take online? Extract online channels from #7

An enormous amount of data is required for a person to live a healthy life. Anyone can organize the information and use it daily, but it requires time and patience. A fitness analyzer keeps track of the goals of the person.

8.2 OFFLINE

What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.

People might see a doctor or an accomplished gym trainer if they are interested in keeping their physical appearance and caring for their health.

Identify strong TR & EM

4. EMOTIONS: BEFORE / AFTER EM

Emotions Before:

they lack the fitness and wellness necessary for living a healthy lifestyle, they eat more junk food.

Emotions After:

Users can maintain and can improve their body

REQUIREMENT ANALYSIS

1. Functional requirement

FR No.	**Functional Requirement (Epic)**	**Sub Requirement (Story / Sub-Task)**
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIn
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User Login	Enter the login ID Enter the associated password given while registering
FR-4	Dataset	Images of different types of fruit are uploaded as part of the dataset
FR-5	Image Input	Interpreting the image input provided by the user
FR-6	Process	Testing the image by various convolution layers
FR-7	Result	Displays the nutrient content of a particular fruit

2. Non-Functional requirements

FR No.	**Non-Functional Requirement**	**Description**

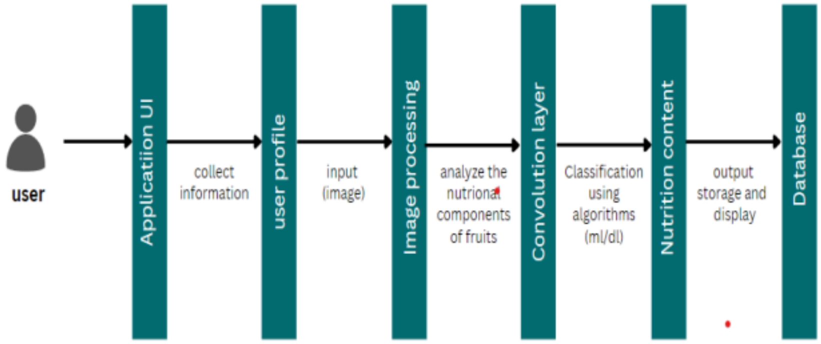
NFR-1	**Usability**	The majority of internet users are on mobile devices, and most of them use some common application to communicate based on its features. It is important that the application is easily accessible by users, and also that the user can report any issues to be resolved as soon as possible.
NFR-2	**Security**	The data is encrypted and highly secured during the logging process, preventing data plagiarism. The application must authenticate and authorize correctly.
NFR-3	**Reliability**	Maintaining calories in your desired food is offered by this application, helping you stay on track with your diet plan. Calories are displayed fairly accurately for the user, which makes it easier for them to maintain a healthy lifestyle
NFR-4	**Performance**	In order to maintain a user and attract new users, the performance of the application must be high enough. A good way to improve performance is by optimizing code, reducing redirects, and also by using Data Structures and Algorithms (DSA).
NFR-5	**Availability**	In addition to its excellent functionality for registered users, the application also has the capability of providing minimum functionality to non-registered users and to reach a wider audience
NFR-6	**Scalability**	A lot of consideration should be put into making the application as scalable as possible so that it can attract more users as their interest increases.

PROJECT DESIGN

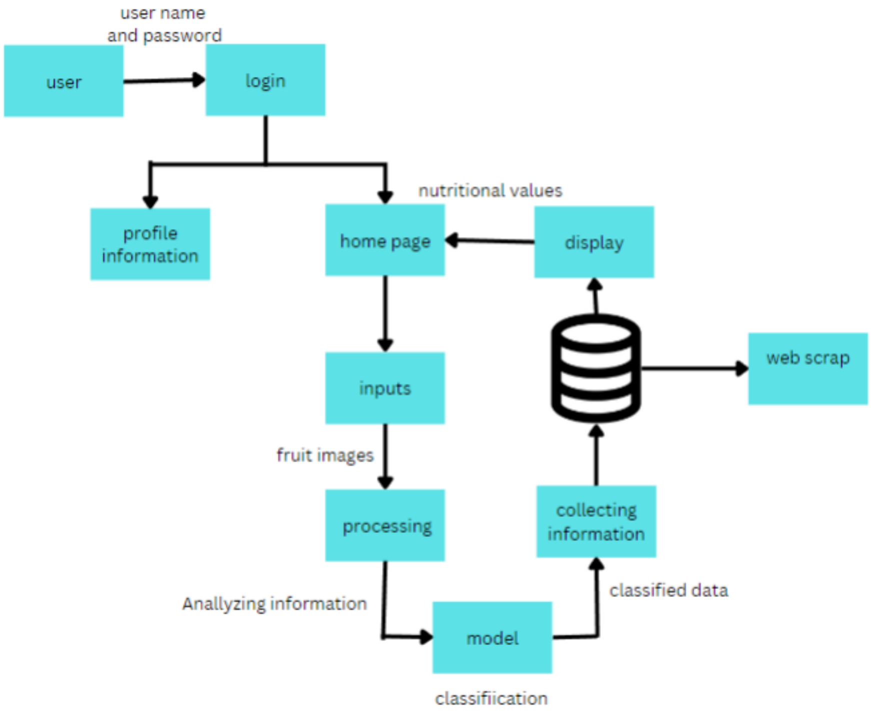
1. Data Flow Diagrams

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored. Simplified diagram

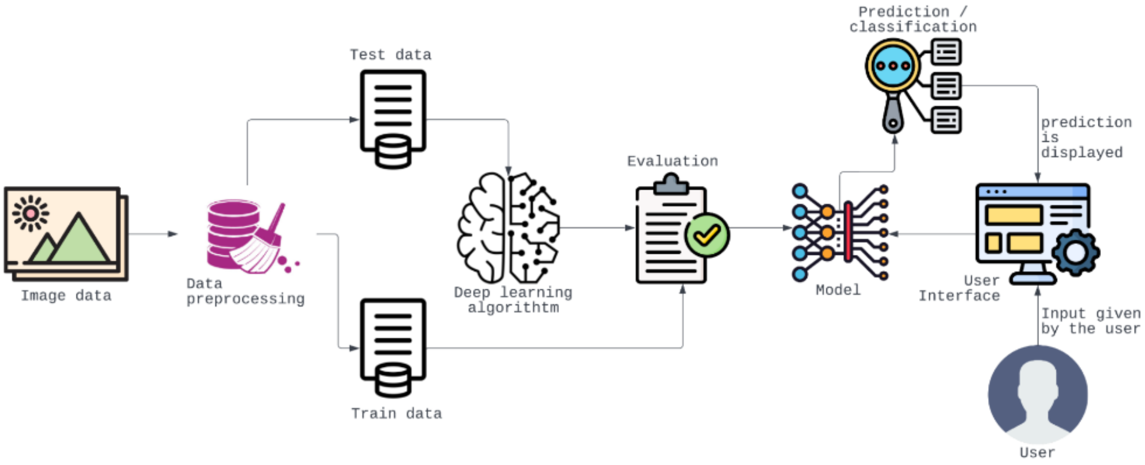
Simplified diagram

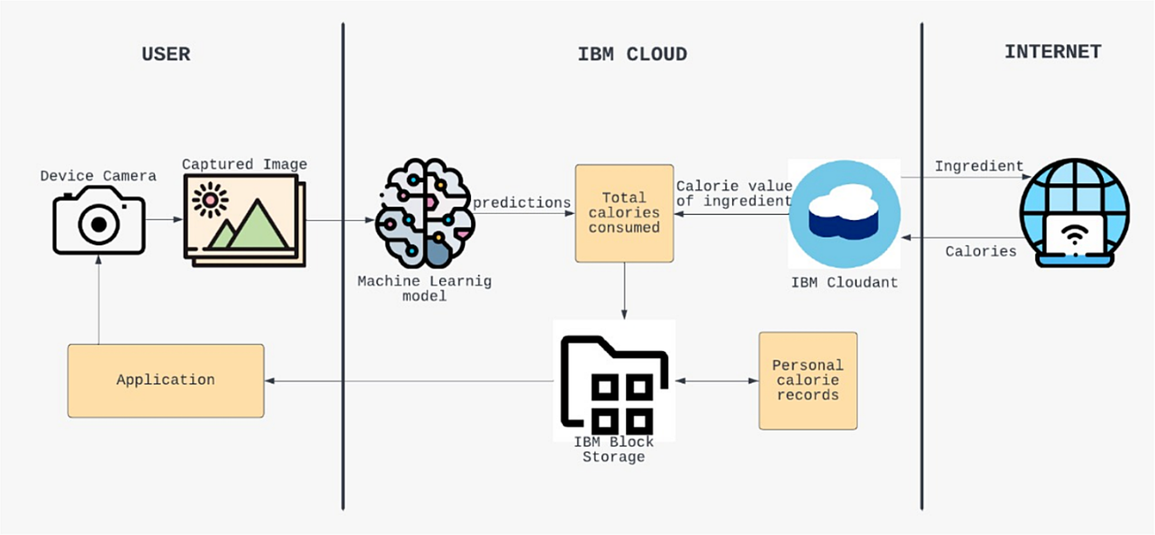


DFD Level 0 (Industry Standard)



2. Solution & Technical Architecture





3. User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail	I can receive conformation mail through gmail	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password	I can log into the system using email and password	High	Sprint-1
	Dashboard	USN - 6	As a user , I can select the list of options provided in the dashboard	I can access the options according to my need	Medium	Sprint-1
Customer (Web user)	Search	USN-7	As a user, I can search for different variety of fruits	I can get the nutrition content of different fruits	High	Sprint-2
	View	USN-8	As a user, I can view the list of fruits	I will get the information such as calories, vitamins	High	Sprint-2
	Notifications	USN-9	As a user, I will receive notifications about variety and textures of different fruits	I will get the frequent update of different fruits	Low	Sprint-2
Customer Care Executive	Mediator	USN-10	As a customer care executive , they could take care of customer feedbacks and solve user requirements	Users can get help and support from customer care executives	Medium	Sprint-2
Administrator	Database	USN-11	As a admin, I will store the user database confidentially	I can store and access data if it is needed infuture	High	Sprint-1
	Data Information	USN-12	As a admin, I will include the dataset for performing various processes	I can store dataset and analyse it	High	Sprint-2
	Processing	USN-13	As a admin, I will use various convolution layers for image processing	I can process using various convolution layers	High	Sprint-2
	Nutrition Analyzer	USN-14	As a admin, I will predict the fruit that has send as input	I can get the nutrition content of particular food after processing and display it	High	Sprint-2

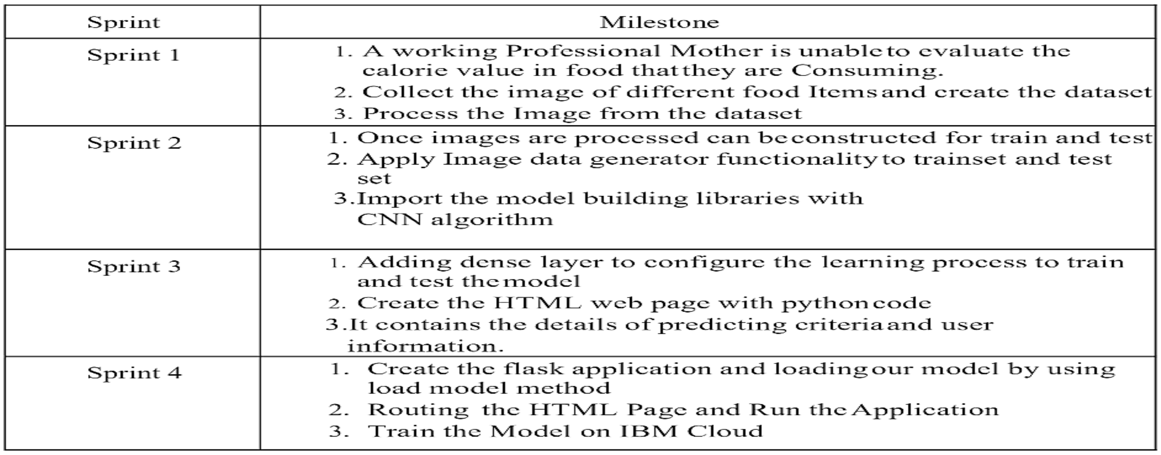
PROJECT PLANNING & SCHEDULING

1. Sprint Planning & Estimation1

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	User story	USN-1	A working Professional Mother is unable to evaluate the calorie value in food that they are Consuming.	4	High	Yogeeswar S
Sprint-1	Data sets	USN-2	Collect the image of different food Items and create the dataset	3	Medium	Sowmya J
Sprint-1	Data Preprocessing	USN-3	Process the Image from the dataset	4	High	Nithya U
Sprint-2	Image processing	USN-4	Once images are processed can be constructed for train and test	3	Medium	Rohan G
Sprint-2	Train and Test	USN-5	Apply Image data generator functionality to trainset and test set	2	Medium	Sowmya J
Sprint-2	Import Model	USN-6	Import the model building libraries with CNN algorithm	5	High	Yogeeswar S
Sprint-3	Configure Model	USN-7	Adding dense layer to configure the learning process to train and test the model	3	High	Rohan G
Sprint-3	Webpage Creation	USN-8	Create the HTML web page with python code	4	Medium	Nithya U
Sprint-3	Dashboard Creation	USN-9	It contains the details of predicting criteria and user information.	3	High	Sowmya J

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-4	Application Creation	USN-10	Create the flask application and loading our model by using load model method	3	Medium	Rohan G
Sprint-4	Application Building	USN-11	Routing the HTML Page and Run the Application	4	High	Yogeeswar S
Sprint-4	Train the Model	USN-12	Train the Model on IBM Cloud	5	High	Yogeeswar S

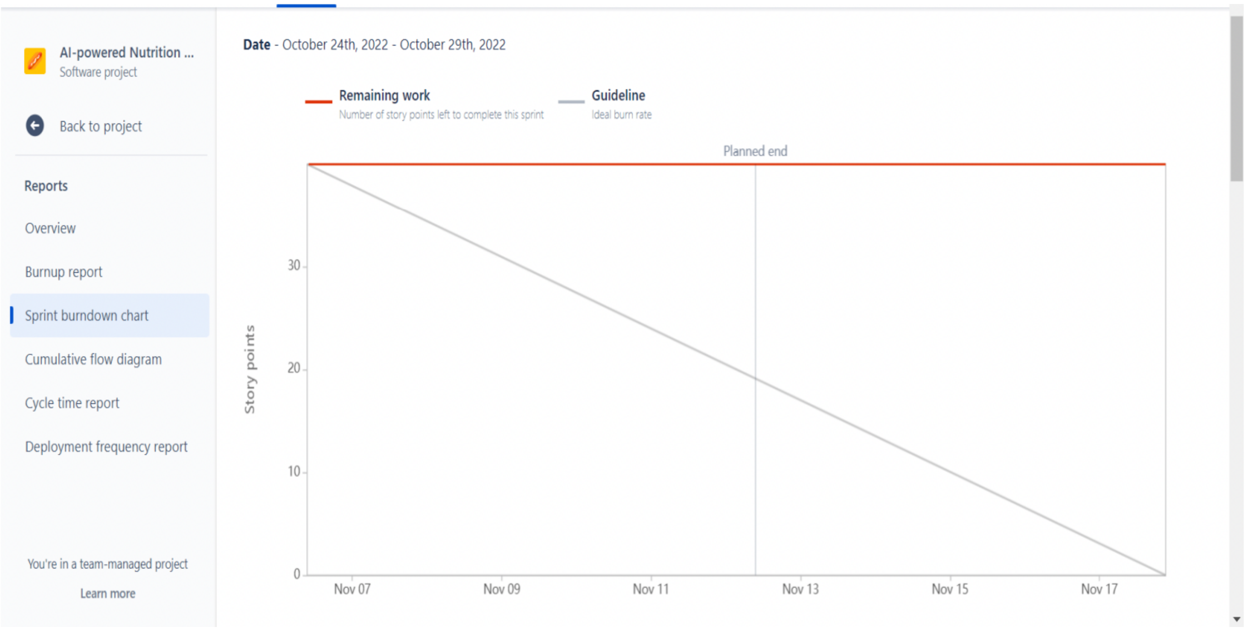
2. Sprint Delivery Schedule



Sprint	Milestone
Sprint 1	1. A working Professional Mother is unable to evaluate the calorie value in food that they are Consuming. 2. Collect the image of different food Items and create the dataset 3. Process the Image from the dataset
Sprint 2	1. Once images are processed can be constructed for train and test 2. Apply Image data generator functionality to trainset and test set 3.Import the model building libraries with CNN algorithm
Sprint 3	1. Adding dense layer to configure the learning process to train and test the model 2. Create the HTML web page with python code 3.It contains the details of predicting criteria and user information.
Sprint 4	1. Create the flask application and loading our model by using load model method 2. Routing the HTML Page and Run the Application 3. Train the Model on IBM Cloud

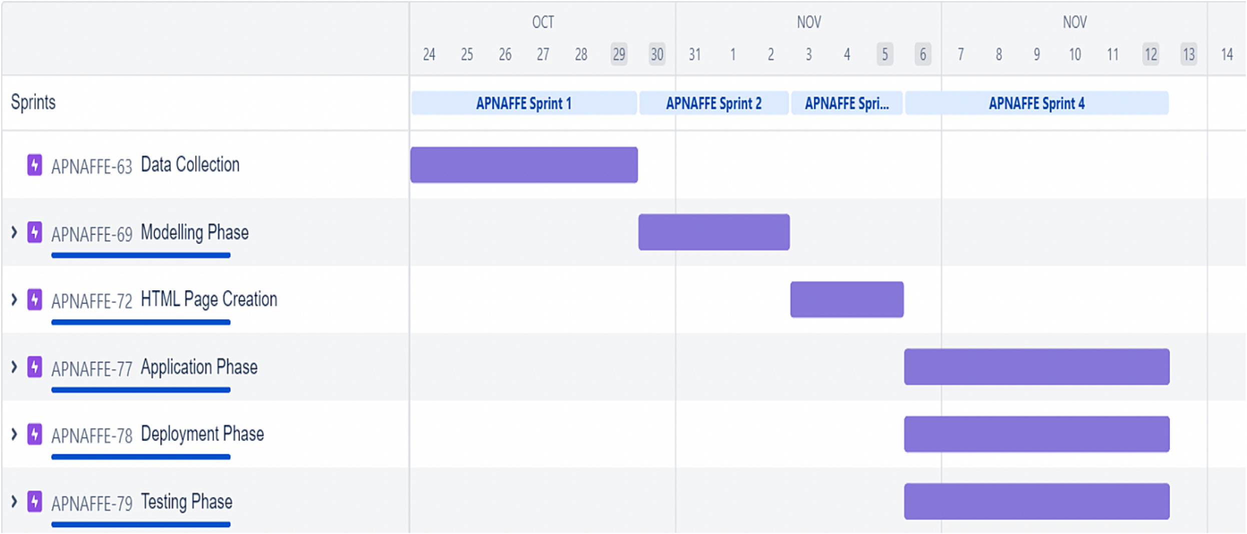
3. Reports from JIRA

BurnDown chart



Date - October 24th, 2022 - October 29th, 2022

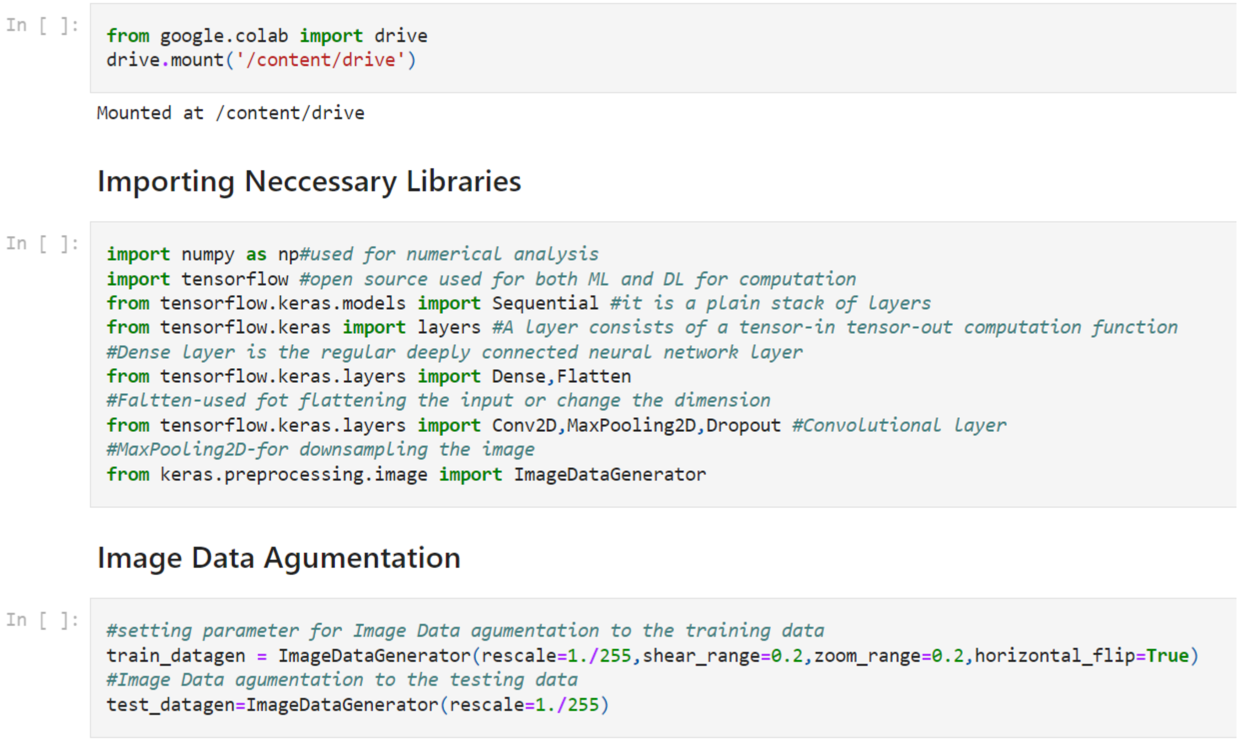
Road Map



CODING & SOLUTIONING

1. **Feature 1 - MODEL BUILDING**

We have created a model for classifying fruits using CNN which is one of the deep learning model. Below explains the model architecture proposed.



In [ ]:

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

Importing Neccessary Libraries

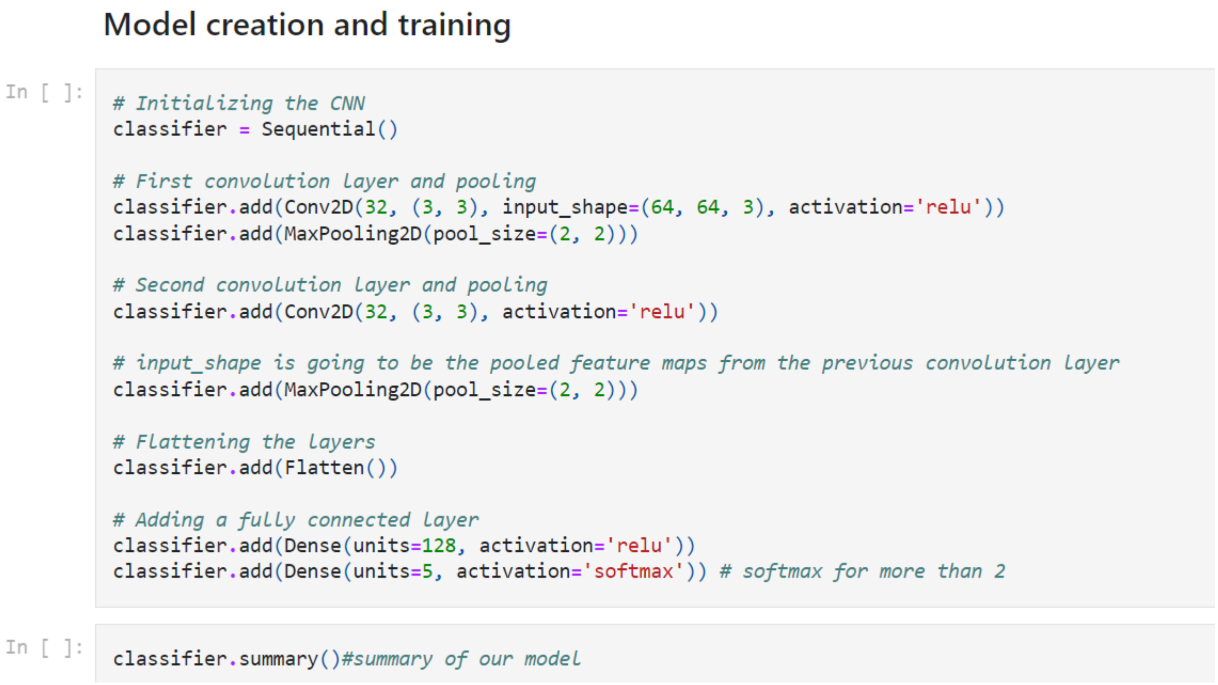
In [ ]:

```
import numpy as np#used for numerical analysis
import tensorflow #open source used for both ML and DL for computation
from tensorflow.keras.models import Sequential #it is a plain stack of layers
from tensorflow.keras import layers #A layer consists of a tensor-in tensor-out computation function
#Dense layer is the regular deeply connected neural network layer
from tensorflow.keras.layers import Dense,Flatten
#Faltten-used fot flattening the input or change the dimension
from tensorflow.keras.layers import Conv2D,MaxPooling2D,Dropout #Convolutional layer
#MaxPooling2D-for downsampling the image
from keras.preprocessing.image import ImageDataGenerator
```

Image Data Agumentation

In [ ]:

```
#setting parameter for Image Data agumentation to the training data
train_datagen = ImageDataGenerator(rescale=1./255,shear_range=0.2,zoom_range=0.2,horizontal_flip=True)
#Image Data agumentation to the testing data
test_datagen=ImageDataGenerator(rescale=1./255)
```



Model creation and training

In [ ]:

```
# Initializing the CNN
classifier = Sequential()

# First convolution layer and pooling
classifier.add(Conv2D(32, (3, 3), input_shape=(64, 64, 3), activation='relu'))
classifier.add(MaxPooling2D(pool_size=(2, 2)))

# Second convolution layer and pooling
classifier.add(Conv2D(32, (3, 3), activation='relu'))

# input_shape is going to be the pooled feature maps from the previous convolution layer
classifier.add(MaxPooling2D(pool_size=(2, 2)))

# Flattening the layers
classifier.add(Flatten())

# Adding a fully connected layer
classifier.add(Dense(units=128, activation='relu'))
classifier.add(Dense(units=5, activation='softmax')) # softmax for more than 2
```

In [ ]:

```
classifier.summary()#summary of our model
```

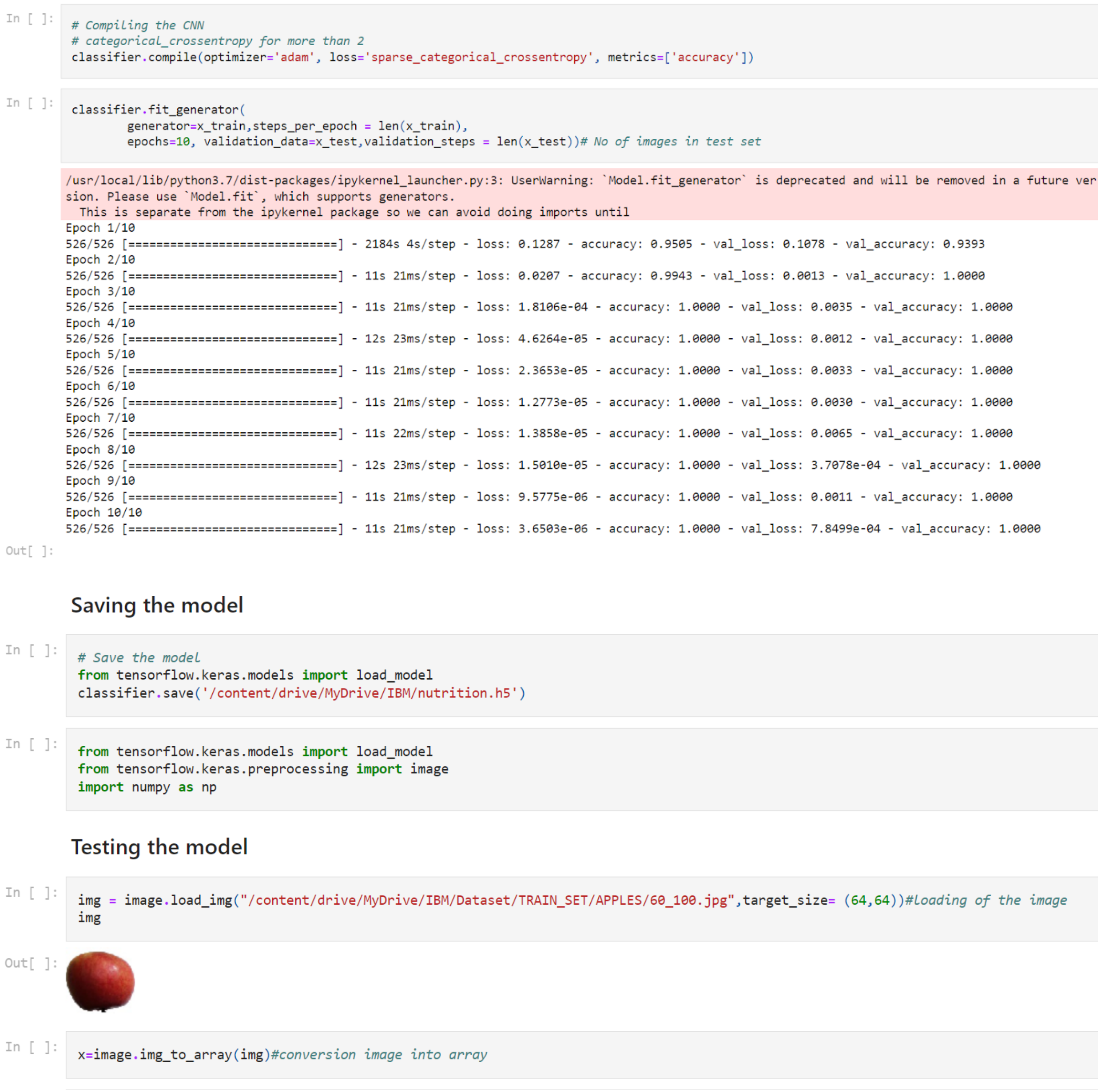
In [ ]:

```
classifier.summary()#summary of our model
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #   
=================================================================
 conv2d (Conv2D)             (None, 62, 62, 32)        896       
                                                                 
 max_pooling2d (MaxPooling2D  (None, 31, 31, 32)       0         
 )                                                               
                                                                 
 conv2d_1 (Conv2D)           (None, 29, 29, 32)        9248      
                                                                 
 max_pooling2d_1 (MaxPooling  (None, 14, 14, 32)       0         
 2D)                                                             
                                                                 
 flatten (Flatten)           (None, 6272)              0         
                                                                 
 dense (Dense)               (None, 128)               802944    
                                                                 
 dense_1 (Dense)             (None, 5)                 645       
                                                                 
=================================================================
Total params: 813,733
Trainable params: 813,733
Non-trainable params: 0
_________________________________________________________________
```

In [ ]:

```
# Compiling the CNN
# categorical_crossentropy for more than 2
classifier.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metrics=['accuracy'])
```



In [ ]:

```
# Compiling the CNN
# categorical_crossentropy for more than 2
classifier.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metrics=['accuracy'])
```

In [ ]:

```
classifier.fit_generator(
        generator=x_train,steps_per_epoch = len(x_train),
        epochs=10, validation_data=x_test,validation_steps = len(x_test))# No of images in test set
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:3: UserWarning: `Model.fit_generator` is deprecated and will be removed in a future ver
sion. Please use `Model.fit`, which supports generators.
  This is separate from the ipykernel package so we can avoid doing imports until
Epoch 1/10
526/526 [==============================] - 2184s 4s/step - loss: 0.1287 - accuracy: 0.9505 - val_loss: 0.1078 - val_accuracy: 0.9393
Epoch 2/10
526/526 [==============================] - 11s 21ms/step - loss: 0.0207 - accuracy: 0.9943 - val_loss: 0.0013 - val_accuracy: 1.0000
Epoch 3/10
526/526 [==============================] - 11s 21ms/step - loss: 1.8106e-04 - accuracy: 1.0000 - val_loss: 0.0035 - val_accuracy: 1.0000
Epoch 4/10
526/526 [==============================] - 12s 23ms/step - loss: 4.6264e-05 - accuracy: 1.0000 - val_loss: 0.0012 - val_accuracy: 1.0000
Epoch 5/10
526/526 [==============================] - 11s 21ms/step - loss: 2.3653e-05 - accuracy: 1.0000 - val_loss: 0.0033 - val_accuracy: 1.0000
Epoch 6/10
526/526 [==============================] - 11s 21ms/step - loss: 1.2773e-05 - accuracy: 1.0000 - val_loss: 0.0030 - val_accuracy: 1.0000
Epoch 7/10
526/526 [==============================] - 11s 22ms/step - loss: 1.3858e-05 - accuracy: 1.0000 - val_loss: 0.0065 - val_accuracy: 1.0000
Epoch 8/10
526/526 [==============================] - 12s 23ms/step - loss: 1.5010e-05 - accuracy: 1.0000 - val_loss: 3.7078e-04 - val_accuracy: 1.0000
Epoch 9/10
526/526 [==============================] - 11s 21ms/step - loss: 9.5775e-06 - accuracy: 1.0000 - val_loss: 0.0011 - val_accuracy: 1.0000
Epoch 10/10
526/526 [==============================] - 11s 21ms/step - loss: 3.6503e-06 - accuracy: 1.0000 - val_loss: 7.8499e-04 - val_accuracy: 1.0000
```

Out[ ]:

Saving the model

In [ ]:

```
# Save the model
from tensorflow.keras.models import load_model
classifier.save('/content/drive/MyDrive/IBM/nutrition.h5')
```

In [ ]:

```
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
import numpy as np
```

Testing the model

In [ ]:

```
img = image.load_img("/content/drive/MyDrive/IBM/Dataset/TRAIN_SET/APPLES/60_100.jpg",target_size= (64,64))#loading of the image
img
```

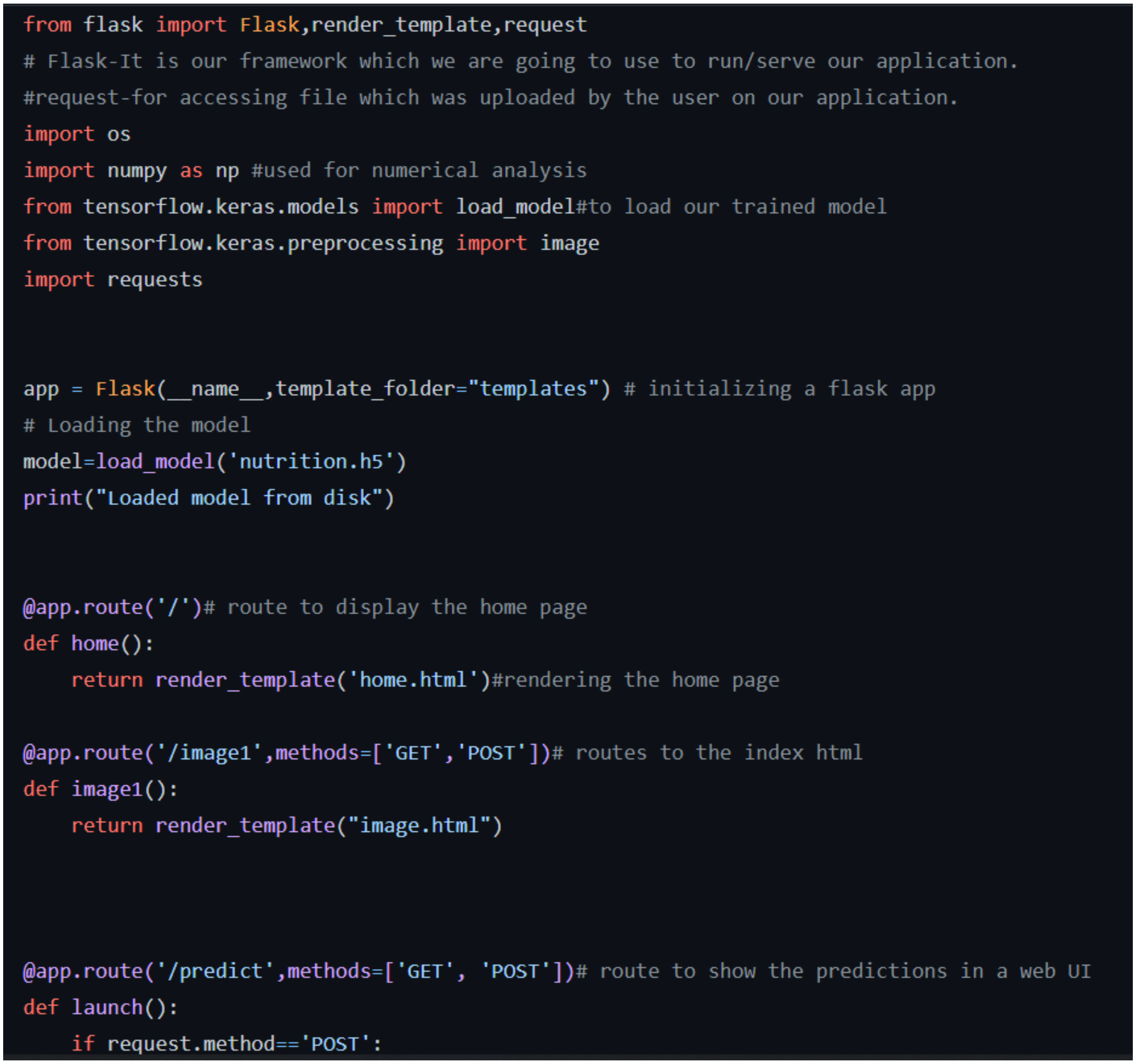
Out[ ]:

In [ ]:

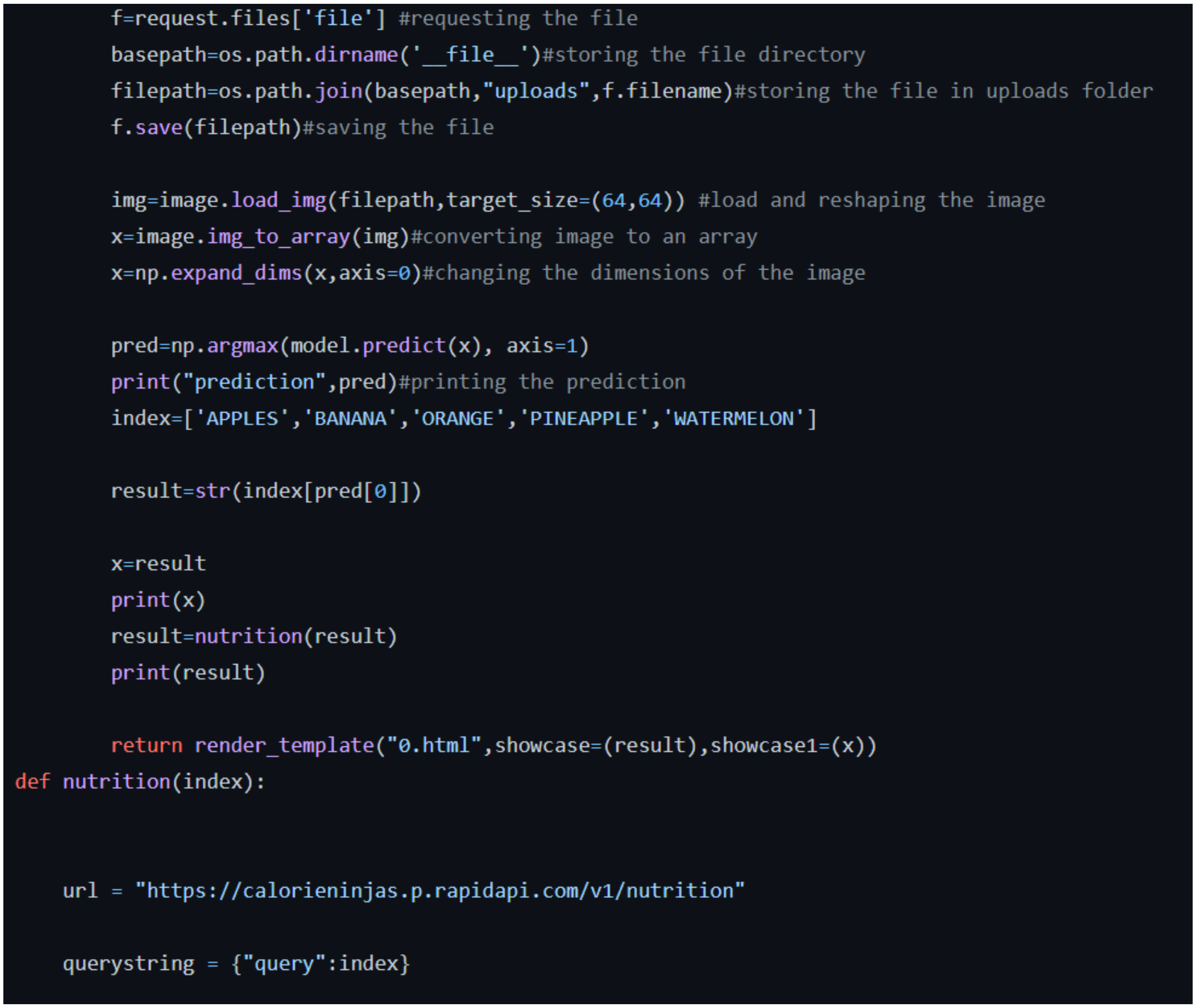
```
x=image.img_to_array(img)#conversion image into array
```

2. **Feature 2 - WEB APPLICATION**

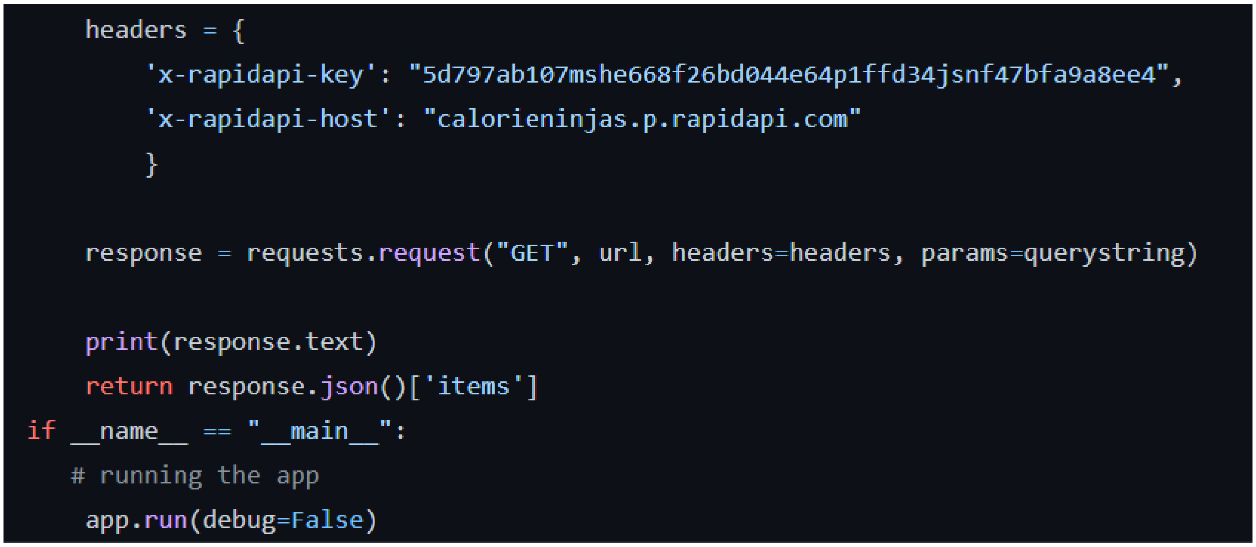
the web application created is used to display the nutrient contents present in that particular food in our case the image will be uploaded by the user and this image will be given to the CNN model which will classify the fruit and with this information the API will return the nutritional contents present in that fruit which will be displayed in the web application for the user.



```
from flask import Flask,render_template,request
# Flask-It is our framework which we are going to use to run/serve our application.
#request-for accessing file which was uploaded by the user on our application.
import os
import numpy as np #used for numerical analysis
from tensorflow.keras.models import load_model#to load our trained model
from tensorflow.keras.preprocessing import image
import requests


app = Flask(__name__,template_folder="templates") # initializing a flask app
# Loading the model
model=load_model('nutrition.h5')
print("Loaded model from disk")


@app.route('/')# route to display the home page
def home():
    return render_template('home.html')#rendering the home page

@app.route('/image1',methods=['GET','POST'])# routes to the index html
def image1():
    return render_template("image.html")



@app.route('/predict',methods=['GET', 'POST'])# route to show the predictions in a web UI
def launch():
    if request.method=='POST':
```



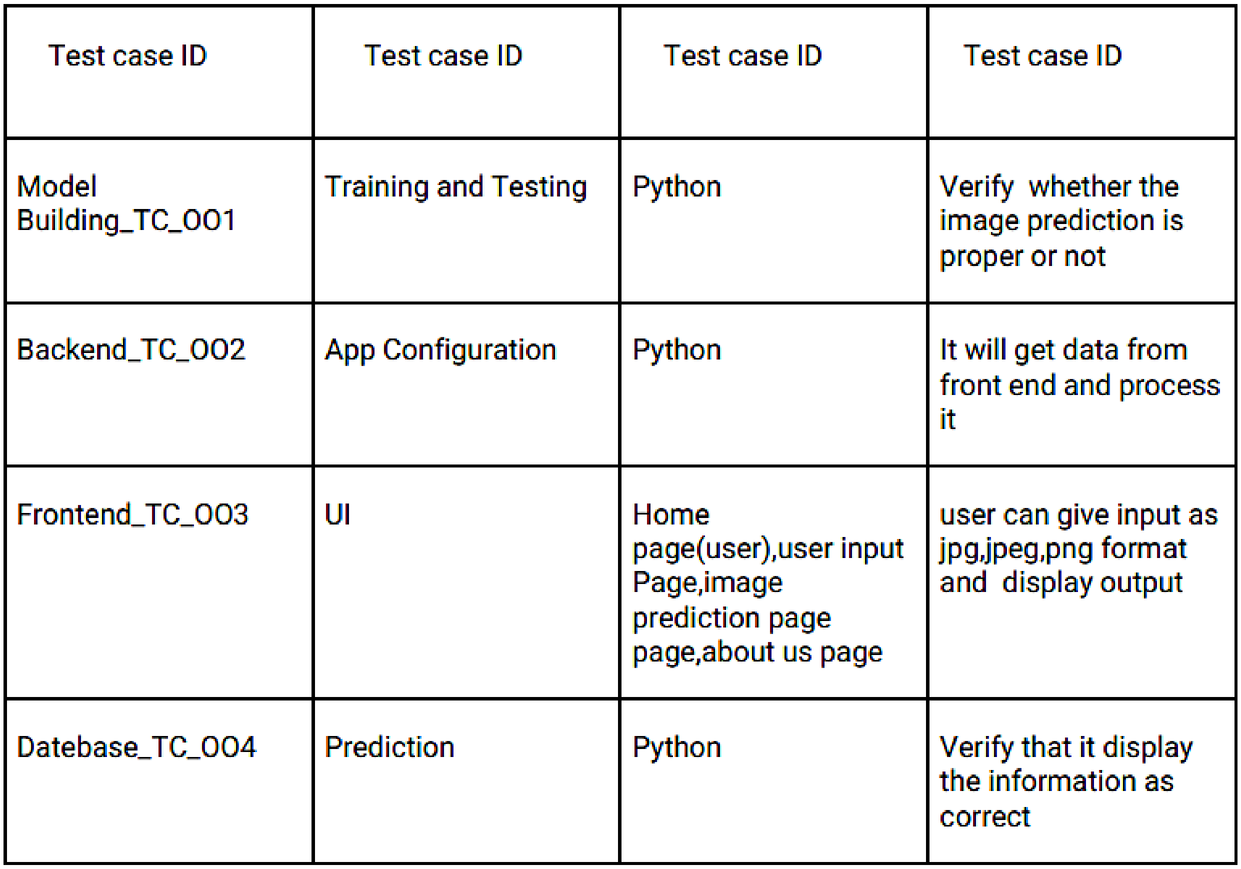
```
        f=request.files['file'] #requesting the file
        basepath=os.path.dirname('__file__')#storing the file directory
        filepath=os.path.join(basepath,"uploads",f.filename)#storing the file in uploads folder
        f.save(filepath)#saving the file

        img=image.load_img(filepath,target_size=(64,64)) #load and reshaping the image
        x=image.img_to_array(img)#converting image to an array
        x=np.expand_dims(x,axis=0)#changing the dimensions of the image

        pred=np.argmax(model.predict(x), axis=1)
        print("prediction",pred)#printing the prediction
        index=['APPLES','BANANA','ORANGE','PINEAPPLE','WATERMELON']

        result=str(index[pred[0]])

        x=result
        print(x)
        result=nutrition(result)
        print(result)

        return render_template("0.html",showcase=(result),showcase1=(x))
def nutrition(index):


    url = "https://calorieninjas.p.rapidapi.com/v1/nutrition"

    querystring = {"query":index}
```



```
    headers = {
        'x-rapidapi-key': "5d797ab107mshe668f26bd044e64p1ffd34jsnf47bfa9a8ee4",
        'x-rapidapi-host': "calorieninjas.p.rapidapi.com"
        }

    response = requests.request("GET", url, headers=headers, params=querystring)

    print(response.text)
    return response.json()['items']
if __name__ == "__main__":
   # running the app
    app.run(debug=False)
```

TESTING

Test Cases



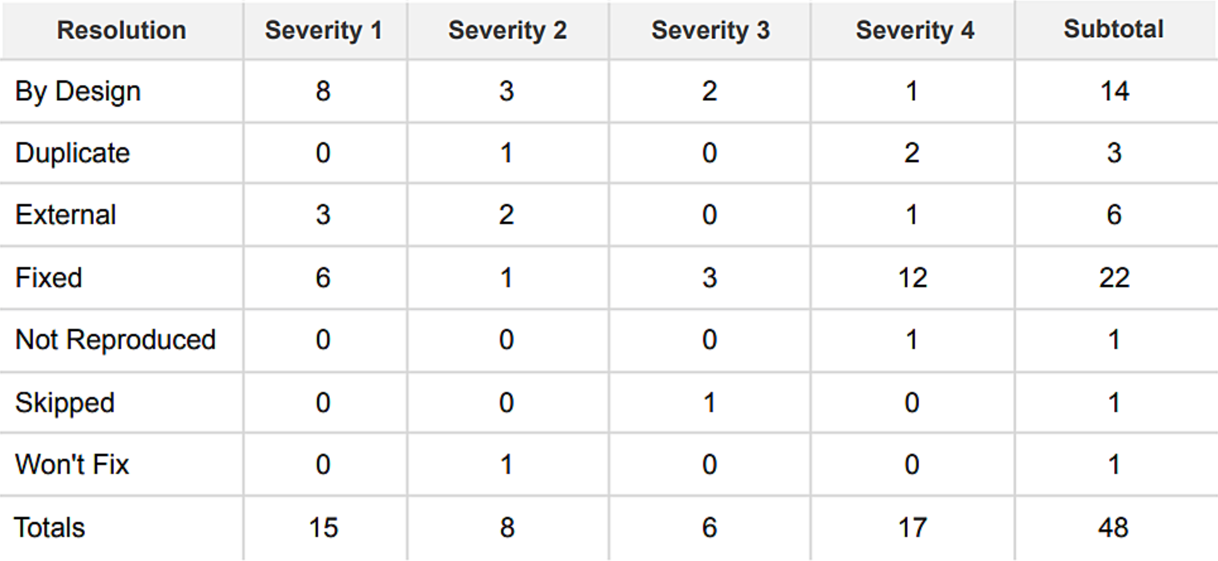
Test case ID	Test case ID	Test case ID	Test case ID
Model Building_TC_OO1	Training and Testing	Python	Verify whether the image prediction is proper or not
Backend_TC_OO2	App Configuration	Python	It will get data from front end and process it
Frontend_TC_OO3	UI	Home page(user),user input Page,image prediction page page,about us page	user can give input as jpg,jpeg,png format and display output
Datebase_TC_OO4	Prediction	Python	Verify that it display the information as correct

Steps to Execute	Test Data	Expected Result	Status	Executed By

1.Importing dataset and unzip it 2.Image preprocessing 3. Add convolution layers and predict fruit	http://127.0.0.1:5000/	Predict the fruit	Pass	NITHYA U
1.APP configuration 2. APP Route	http://127.0.0.1:5000/	Users data should process In Backend it should get data from frontend and display output.	Pass	ROHAN G

1.Enter the input image 2.Pick the image format as jpg,png,jpeg 3.Click submit	http://127.0.0.1:5000/ http://127.0.0.1:5000/image/ http://127.0.0.1:5000/imageprediction	User should navigate to home page and required pages they want to go.	Pass	S YOGEESWAR
1.displaying the nutrient values from api after user clicks submit button	http://127.0.0.1:5000/imageprediction	Display data returned by the API	Pass	SOWMYA J

User Acceptance Testing



Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	8	3	2	1	14
Duplicate	0	1	0	2	3
External	3	2	0	1	6
Fixed	6	1	3	12	22
Not Reproduced	0	0	0	1	1
Skipped	0	0	1	0	1
Won't Fix	0	1	0	0	1
Totals	15	8	6	17	48

Section	Total Cases	Not Tested	Fail	Pass
Routing to pages	2	0	0	2
Client Application	4	0	0	4
Security	4	0	0	4
Image prediction	5	0	0	5
Final Output	5	0	0	5

RESULTS

1. Performance Metrics

NFT - Risk Assessment

Project Name	Scope	Functional Changes	Hardware Changes	Software Changes	Impact of Downtime	Risk Score
AI-powered Nutrition Analyzer for Fitness Enthusiats	New	Low	Moderate	Moderate	Low	GREEN

NFT - Detailed Test Plan

S.No	Project Overview	NFT Test approach	Assumptions/Dependencies/Risks	Approvals/SignOff
1	Display nutrient content	Stress	App Crash/ Developer team/ Site Down	Approved
2	Display nutrient content	Load	Server Crash/ Developer team	Approved

End Of Test Report

NFR - Met	Test Outcome	GO/NO-GO decision	Recommendations	Identified Defects (Detected/Closed/Open)
Performance	CPU -01	GO	High Performance	Closed
Database Information	Storage	NO-GO	SQLlite for access	Closed

ADVANTAGES & DISADVANTAGES

The advantages of this project includes better understanding of the food characterization. It helps individuals to live a healthier and better life by analyzing the fruits they eat and by providing a fitness goal and benefits based on that. The disadvantages involve the time required to build the model and analyzation of the fruits.The efficiency of the model could be improved by reducing time complexity of the classification by providing better image capturing and datasets.

CONCLUSION

Images of Different types of fruits are captured for classification and analyzed based on different characteristics like colour , shape, texture etc so as to provide an intellect about the nutritional characterization and benefits present in them. This model helps fitness enthusiasts and health conscious people in their journey to better understand their food and hygiene habits so as to hold a healthier life.

FUTURE SCOPE

Various food habits and fitness recommendations can be incorporated into the model so as to make it more efficient and useful to the fitness enthusiasts. Timely reminders, daily tasks and task completion updates could be provided to make the model more interactive.

main future scope is as follows,

1. Based On Reviews: In future the feedback is asked from users to meet their expectations like additional features such as BMI calculation,daily calorie intake calculator and various features.

2. Nutritional Chatbot: In future the nutrition chatbot will be used.It can have various type of input such as speech recognition,image input,input as name and will give output in form of voice or text .Analyzing according to the bowl size.We will try to take the disadvantages as the challenge and make it possible in the upcomings.

APPENDIX

Source Code

AI_Powered_Nutrition_Analyzer.ipynb

```
import numpy as np#used for numerical analysis
import tensorflow #open source used for both ML and DL for computation
from tensorflow.keras.models import Sequential #it is a plain stack of layers
from tensorflow.keras import layers #A layer consists of a tensor-in tensor-out computation function
#Dense layer is the regular deeply connected neural network layer
from tensorflow.keras.layers import Dense,Flatten
#Faltten-used fot flattening the input or change the dimension
from tensorflow.keras.layers import Conv2D,MaxPooling2D,Dropout #Convolutional layer
#MaxPooling2D-for downsampling the image
from keras.preprocessing.image import ImageDataGenerator

#setting parameter for Image Data agumentation to the training data
train_datagen = ImageDataGenerator(rescale=1./255,shear_range=0.2,zoom_range=0.2,horizontal_flip=True)
#Image Data agumentation to the testing data
test_datagen=ImageDataGenerator(rescale=1./25

#performing data agumentation to train data
x_train = train_datagen.flow_from_directory(


x_test = test_datagen.flow_from_directory( r'/content/drive/MyDrive/IBM/Dataset/TEST_SET',
target_size=(64, 64),batch_size=5,color_mode='rgb',class_mode='sparse')
print(x_train.class_indices)#checking the number of classes
print(x_test.class_indices)#checking the number of classes
from collections import Counter as c
c(x_train .labels)
```

```
# Initializing the CNN
classifier = Sequential()

# First convolution layer and pooling
classifier.add(Conv2D(32, (3, 3), input_shape=(64, 64, 3), activation='relu'))
classifier.add(MaxPooling2D(pool_size=(2, 2)))

# Second convolution layer and pooling
classifier.add(Conv2D(32, (3, 3), activation='relu'))

# input_shape is going to be the pooled feature maps from the previous convolution layer
classifier.add(MaxPooling2D(pool_size=(2, 2)))

# Flattening the layers
classifier.add(Flatten())

# Adding a fully connected layer
classifier.add(Dense(units=128, activation='relu'))
classifier.add(Dense(units=5, activation='softmax')) # softmax for more than 2
 classifier.summary()#summary of our model
# Compiling the CNN
# categorical_crossentropy for more than 2
classifier.compile(optimizer='adam',                          loss='sparse_categorical_crossentropy',
metrics=['accuracy'])
classifier.fit_generator(
        generator=x_train,steps_per_epoch = len(x_train),
         epochs=10, validation_data=x_test,validation_steps = len(x_
Save the model
from tensorflow.keras.models import load_model
```

```
classifier.save('/content/drive/MyDrive/IBM/nutrition.h5')

from tensorflow.keras.models import load_model

from tensorflow.keras.preprocessing import image

 import numpy as np

img =
image.load_img("/content/drive/MyDrive/IBM/Dataset/TRAIN_SET/APPLES/60_100.jpg",target_
size= (64,64))#loading of the image

img
x=image.img_to_array(img)#conversion image into array
classifier = load_model("/content/drive/MyDrive/IBM/nutrition.h5") In [ ]:

pred = classifier.predict(x)
```

Image_Preprocessing.ipynb

```
import numpy as np#used for numerical analysis

import tensorflow #open source used for both ML and DL for computation

from tensorflow.keras.models import Sequential #it is a plain stack of layers

from tensorflow.keras import layers #A layer consists of a tensor-in tensor-out computation
function

#Dense layer is the regular deeply connected neural network layer

from tensorflow.keras.layers import Dense,Flatten

#Faltten-used fot flattening the input or change the dimension

from tensorflow.keras.layers import Conv2D,MaxPooling2D,Dropout #Convolutional layer

#MaxPooling2D-for downsampling the image

from keras.preprocessing.image import ImageDataGenerator
#setting parameter for Image Data agumentation to the training data

train_datagen =
ImageDataGenerator(rescale=1./255,shear_range=0.2,zoom_range=0.2,horizontal_flip=True)

#Image Data agumentation to the testing data

test_datagen=ImageDataGenerator(rescale=1./255)
#performing data agumentation to train data
```

```
x_train = train_datagen.flow_from_directory(
    r'/content/drive/MyDrive/Colab Notebooks/Dataset/TRAIN_SET',
    target_size=(64, 64),batch_size=5,color_mode='rgb',class_mode='sparse')
#performing data agumentation to test data
x_test = test_datagen.flow_from_directory(
    r'/content/drive/MyDrive/Colab Notebooks/Dataset/TEST_SET',
    target_size=(64, 64),batch_size=5,color_mode='rgb',class_mode
print(x_train.class_indices)#checking the number of classes
print(x_test.class_indices)#checking the number of classes
from collections import Counter as c
c(x_train .labels)
```

app.py

```
from flask import Flask,render_template,request
# Flask-It is our framework which we are going to use to run/serve our application.
#request-for accessing file which was uploaded by the user on our application.
import os
import numpy as np #used for numerical analysis
from tensorflow.keras.models import load_model#to load our trained model
from tensorflow.keras.preprocessing import image
import requests

app = Flask(__name__,template_folder="templates") # initializing a flask app
# Loading the model
model=load_model('nutrition.h5')
print("Loaded model from disk")

@app.route('/')# route to display the home page
def home():
    return render_template('home.html')#rendering the home page
```

```
@app.route('/image1',methods=['GET','POST'])# routes to the index html
def image1():
    return render_template("image.html")


@app.route('/predict',methods=['GET', 'POST'])# route to show the predictions in a web UI
def launch():
    if request.method=='POST':
        f=request.files['file'] #requesting the file
        basepath=os.path.dirname('__file__')#storing the file directory
        filepath=os.path.join(basepath,"uploads",f.filename)#storing the file in uploads folder
        f.save(filepath)#saving the file

        img=image.load_img(filepath,target_size=(64,64)) #load and reshaping the image
        x=image.img_to_array(img)#converting image to an array
        x=np.expand_dims(x,axis=0)#changing the dimensions of the image

        pred=np.argmax(model.predict(x), axis=1)
        print("prediction",pred)#printing the prediction
        index=['APPLES','BANANA','ORANGE','PINEAPPLE','WATERMELON']

        result=str(index[pred[0]])


        x=result
        print(x)
        result=nutrition(result)
        print(result)


        return render_template("0.html",showcase=(result),showcase1=(x))
```

```
def nutrition(index):

    url = "https://calorieninjas.p.rapidapi.com/v1/nutrition"


    querystring = {"query":index}


    headers = {
        'x-rapidapi-key': "5d797ab107mshe668f26bd044e64p1ffd34jsnf47bfa9a8ee4",
        'x-rapidapi-host': "calorieninjas.p.rapidapi.com"
        }


    response = requests.request("GET", url, headers=headers, params=querystring)


    print(response.text)
    return response.json()['items']
if __name__ == "__main__":
```

GitHub & Project Demo Link

GITHUB LINK: https://github.com/IBM-EPBL/IBM-Project-5176-1658750221

PROJECT DEMO LINK:
https://drive.google.com/file/d/1xR_4lVuHP71AVmvQNghgc9dTg8Ggfsfh/view?usp=share_link