PROJECT REPORT

AI-POWERED NUTRITION ANALYZER FOR FITNESS ENTHUSIASTS

Submitted by
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INTRODUCTION

1.1 Project Overview

Food is the major source of nutrients in our body. Nutrition is the process by which important beneficial biomolecules or nutrients, after reaching their destination within the body, positively helps in functioning, maintaining, or improving important bio metabolisms. We can classify the nutrients into macro (consisting of carbohydrates, proteins and fats) and micro (consisting of minerals and vitamins).

Most diseases are inextricably linked to diet. A diet rich in fruits can lower blood pressure, reduce the risk of heart disease and stroke, prevent some types of cancer, lower risk of eye and digestive problems, and have a positive effect upon blood sugar, which can help keep appetite in check. Our project through dietary assessment and nutrition analysis tools enable more opportunities to help people understand their daily eating habits, to explore nutrition patterns and maintain a healthy diet. The user can upload the images of different fruits, and the trained model analyses the image and detects the nutrition based on the fruits like (Sugar, Fibre, Protein, Calorie intake, etc.). The main aim 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.

1.2 Purpose

Through the project the user will be able to:

- Determine the component nutrients present in the captured fruit item. If the consumer has a clear idea about the food component, he or she may choose or reject specific food items according to his or her health condition.
- Calculate the amount of calories just from the picture.
- Understand and analyse big data, including factors influencing their nutritional needs.
- Make dynamic and adaptive macronutrient adjustments thus providing high-quality nutrient plans each week .

The development of AI powered nutrition systems in dietetics may lead, in the near future, to a partial replacement of medical personnel and reducing the need for personal contact with a nutritionist.

2. LITERATURE SURVEY

2.1 Existing problem

The use of computerized food composition databases for applications such as dietary studies, nutritional labelling and food product development has increased considerably in recent years. Unfortunately, some nutritional software packages

are of poor quality, and the technical support provided to users is sometimes inadequate. Although many excellent software packages and databases are available, they are open to misuse by users who do not understand or appreciate the limitations of such systems.

The problem in nutrient research is not currently obtaining more and more advanced algorithms. Past techniques have suffered from a lack of accuracy in recording, as recall methods may not accurately record the food consumed or have difficulty estimating portion sizes or limited food ingredient lists. The coding and translation of food records from nutrition surveys into nutrient analyses are labour-intensive and time-consuming, meaning that it is more difficult to collect detailed information regarding food intake in large scale population studies.

Digitization in electronic format (i.e., EHRs - clinical repositories wherein longitudinal patient health information is generated in real time) can cause

i) improper standardization formats

ii) erroneous documentation and incorrect reporting

iii) lack of user engagement if not trained

Year	Title	Link	Inference
2019	Image based fruit category classification by 13-layer deep convolutional neural network and data augmentation	https://www.researchgate.net/publication/320127875_Image_based_fruit_category_classification_by_13-layer_deep_convolutional_neural_network_and_data_augmentation	Three types of data augmentation method was used: image rotation, Gamma correction, and noise injection. A 13-layer convolutional neural network was used which validated the optimal number of convolution layers and pooling layers. Comparison between CPU and GPU computation was done, and it was found that GPU can achieve a 177x acceleration on training data, and a 175x acceleration on test data.

2018	Methodologies for Classification, Maturity Detection, Defect Identification and Grading of Fruits	https://www.ijcaonline.org/archives/volume180/number36/reshma-2018-ijca-916897.pdf	We found that the use of fruits may decrease cardiovascular diseases and cancer. Pre processing and feature extraction is the two common process of Classification, grading, maturity identification and defect detection.
2017	Automatic Classification of South Indian Regional Fruits using Image Processing	https://www.researchgate.net/publication/317112806_Automatic_Classification_of_South_Indian_Regional_Fruits_using_Image_Processing	The fruits are classified based on Extraction of morphological and Fourier features of a fruit image by applying DTNB classifier.Background elimination is the first step employed, and is given based on the threshold technique. This helps in extracting only the interested pixel regions. SVM (Support Vector Machine), neural network, KNN classifiers etc. were mostly used for Automatic classification of fruits.
2016	Classification Of Selected Apple Fruit varieties using NAIVE BAYES	https://www.researchgate.net/publication/296832034_CLASSIFICATION_OF_SELECTED_APPLE_FRUIT_VARIETIES_USING_NAIVE_BAYES	Applicability and performance of Naive Bayes algorithm in the classification of apple fruit varieties was understood. The methodology involved was image acquisition, pre-processing and segmentation.This study indicated that Naive Bayes has good potential for identification of apple varieties nondestructively and accurately.

2.2 REFERENCES

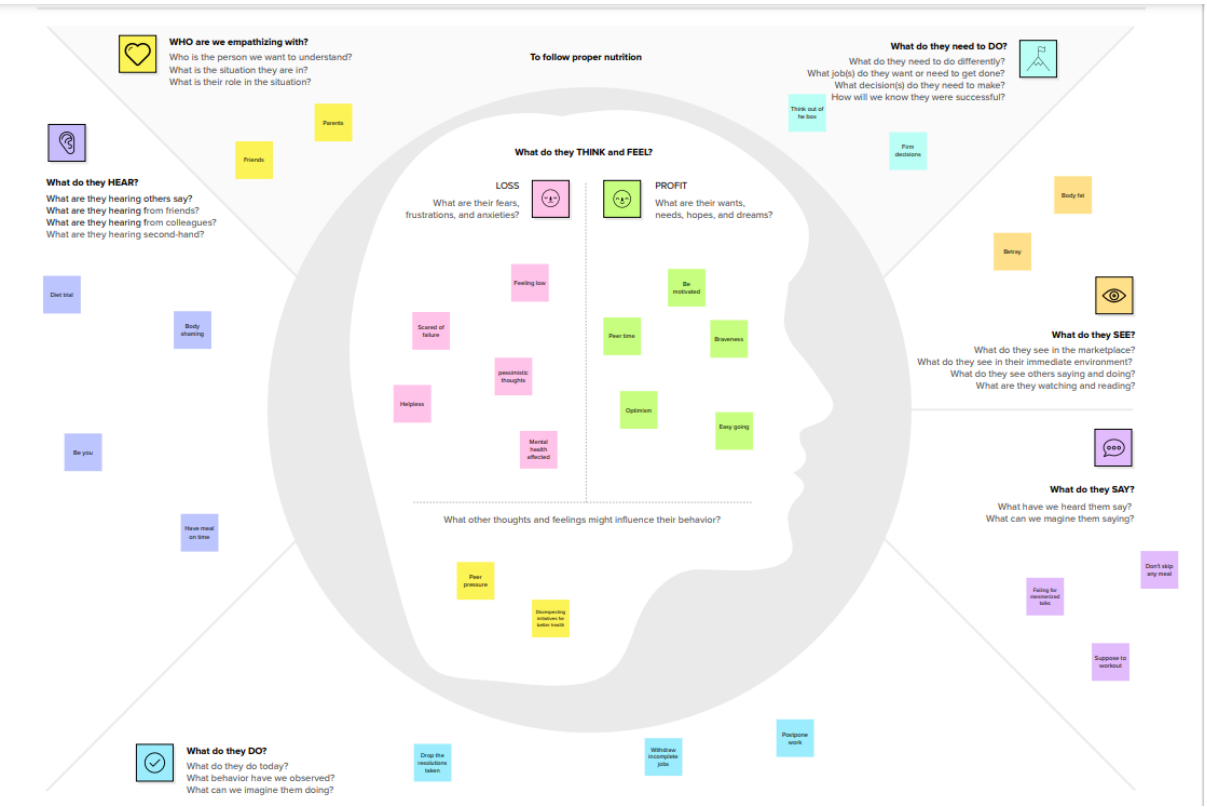
Reference Paper 1:
Jana, Susovan & Parekh, Ranjan & Sarkar, Bijan. (2020). Automatic Classification of Fruits and Vegetables: A Texture-Based Approach. 10.1007/978-981-15-1041-0_5.
Reference Paper 2:
Zhang, Yu-Dong & Dong, Zhengchao & Chen, Xianqing & Jia, Wenjuan & Du, Sidan & Muhammad, Khan & Wang, Shuihua. (2019). Image based fruit category classification by 13-layer deep convolutional neural network and data augmentation. Multimedia Tools and Applications. 78. 1-20. 10.1007/s11042-017-5243-3.
Reference Paper 3:
R., Reshma & K., Sreekumar. (2018). A Literature Survey on Methodologies for Classification, Maturity Detection, Defect Identification and Grading of Fruits. International Journal of Computer Applications. 180. 18-22. 10.5120/ijca2018916897.
Reference paper 4:
Sahana, M. & Anita, H.. (2017). Automatic Classification of South Indian Regional Fruits using Image Processing. Indian Journal of Science and Technology. 10. 1-4. 10.17485/ijst/2017/v10i13/110462.
Reference paper 5:
Misigo, Ronald & Kirimi, Evans. (2016). CLASSIFICATION OF SELECTED APPLE FRUIT VARIETIES USING NAIVE BAYES. Indian Journal of Computer Science and Engineering (IJCSE). 7. 13.
Reference paper 6:
Kim, Jang-yoon & Vogl, Michael & Kim, Shin-Dug. (2015). A Code Based Fruit Recognition Method Via Image Conversion Using Multiple Features. 2014 International Conference on IT Convergence and Security, ICITCS 2014. 10.1109/ICITCS.2014.7021706.

2.3 Problem Statement Definition

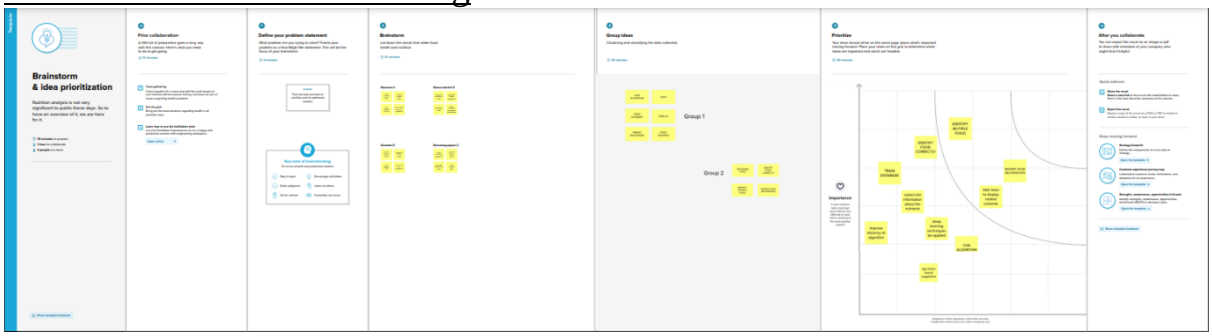
To provide a nutrition-based data platform that mainly caters to fitness freaks who are trying to follow a diet-plan but couldn't do it on a daily basis which makes them feel demotivated.

3. IDEATION AND PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation and Brainstorming



3.3 Proposed Solution

S.No	Parameter	Description
1.	Problem Statement (Problem to be solved)	The main aim of the project is to build a model which is used for identifying the fruit depending on the different characteristics like color, shape, texture etc using image processing. Here the user can capture the images of different fruits and then the image will be analyzed with the trained model. The model analyzes the image and lists

		out the nutrients present in the fruit like sugar, vitamins, minerals, protein etc
2.	Idea / Solution description	To identify the given input data and to provide nutritional facts based on the obtained data.
3.	Novelty / Uniqueness	The user can upload the images of different fruits, and the trained model analyzes the image and detects the nutrition based on the fruits like (Sugar, Fibre, Protein, Calorie intake, etc.). CNN algorithm is used for Fruit Recognition using Colour and Texture Features and to classify the nutrition values.
4.	Social Impact / Customer Satisfaction	Improvement in their nutritional values Automatic fitness analyser and calorie management
5.	Business Model (Revenue Model)	Advices from expert Social media advertisement to attract people Allowing third-party vendors (Nutritional Products) advertisements
6.	Scalability of the Solution	Collecting more varieties of food data expands the application and improves the accuracy Further nutritional values can be added to improve maternal, child nutrition and various health problems

Using AI as well as image classification technology for identifying the food accurately. It even calculates the number of calories just from the picture. The proprietary API, known as Food AI, has been trained to identify fruits around the globe.

3.4 Problem Solution Fit

1. CUSTOMER SEGMENTS

   People belonging to any age group who wish to follow a nutritious diet plan

2. JOBS-TO-BE-DONE / PROBLEMS

   To build a model for classifying the fruits depending on the different characteristics such as color, shape, texture etc. and to detect the nutrition based on the fruit like (Sugar, Fibre, Protein, Calories, etc.)

3. TRIGGERS

   An unhealthy person who wishes to change their diet and consume nutritious food according to their health.

4. EMOTIONS: BEFORE / AFTER

   Before: Confusion over the classification of fruits that they have to take appropriately
   After: Lucid idea regarding the intake of fruits.

5. AVAILABLE SOLUTIONS

   Customer can instantly identify the nutrition by uploading their own fruit image.

6. CUSTOMER CONSTRAINTS

   The model is restricted to only fruits and its nutritional values

7. BEHAVIOUR

   Find the correct fruit for them according to the nutritional

8. CHANNELS OF BEHAVIOUR

   Online: They can choose the fruits according to their diet preferences
   Offline: They can follow the preferred results to improve their fitness

9. PROBLEM ROOT CAUSE

   Nutritional intake in foods needs to be monitored because of the increase in health issues. Also, nutrition intake is mandatory to maintain fitness.

10. YOUR SOLUTION

    To train a model that classifies the fruits based on their characteristics and finally outputs the nutritional values like sugar, fiber etc. using deep convolutional layers.

4. REQUIREMENT ANALYSIS

4.1 Functional Requirement

FR No.	Functional Requirements (Epic)	Sub Requirements (Story / Sub - Task)
FR - 1	Model Building	Get fruits image as user input and obtain nutritional classification of each fruit.
FR - 2	HTML Pages	Create UI based HTML pages and import flask modules and necessary libraries.
FR - 3	Flask Application	Create a flask application, load python model and API integration to take input images from the application.
FR - 4	IBM Cloud	Train the model on IBM cloud

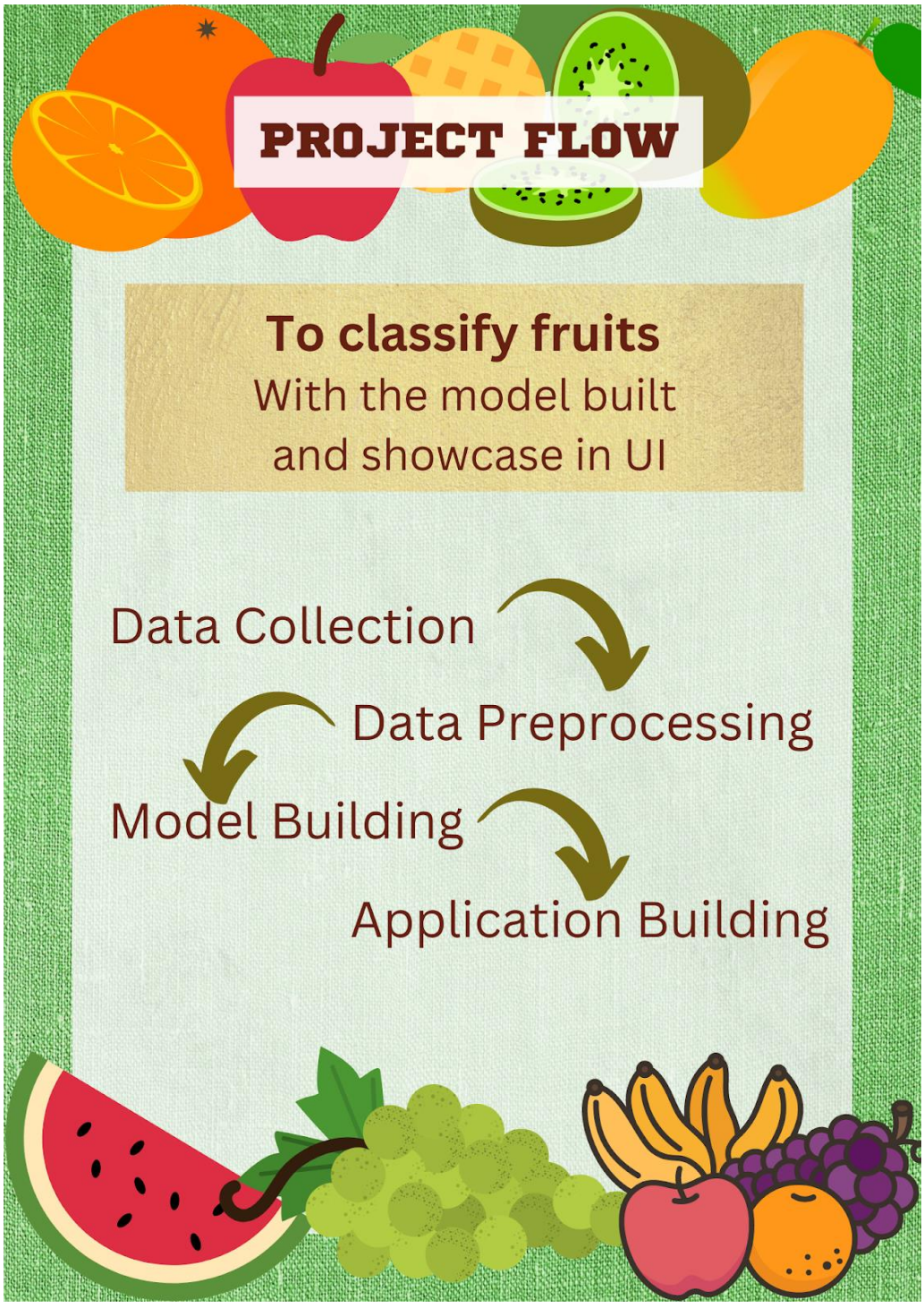
4.2 Non - functional Requirement

NFR No.	Non-Functional Requirement	Description
NFR-1	Usability	Supports all the type of users with any desktop OS and mobile services
NFR-2	Security	Data, image provided and the results of the user are confidential and will not be shared to the other users
NFR-3	Reliability	The results obtained are highly reliable and users are allowed to report in case of wrong functionality of the website
NFR-4	Performance	It can support any number of images and can provide accurate results for all the users concurrently accessing the analyser
NFR-5	Availability	The website service will be available all the time

NFR-6	Scalability	Ability to change the model to accommodate many numbers of users

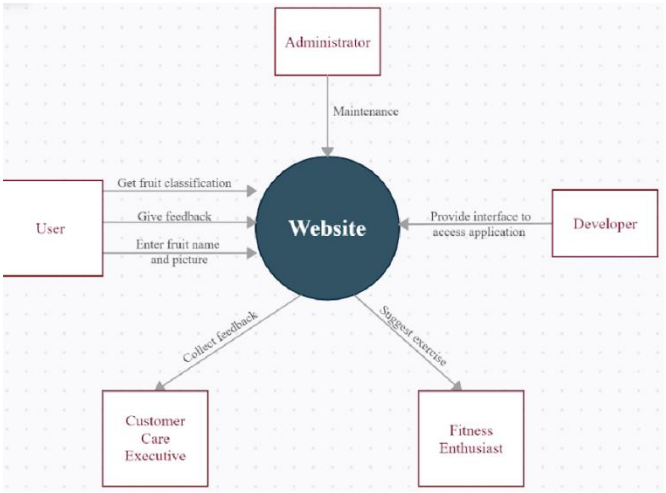
5. PROJECT DESIGN

The design is completely software specific, path leads like customer journey map, data flow diagram, solution and technical architecture as well as user stories are well defined before the start of project.



5.1 Data Flow Diagrams

This diagram shows the view of the overall project with users and their respective roles.



The arrow marks indicate the directional flow of data and the duty assigned for specific users is well defined.

5.2 Solution & Technical Architecture

Solution relies on the requirements based on a specific job. Components and technologies used in this website are:

- HTML and flask:
  Websites are designed using HTML pages with user friendly accessible tabs, menus and buttons. CSS is also used to describe the style of HTML documents. Its various tags, elements, design options, alignments. The structure of the website can be well defined easily. Bootstrap features are very responsive and thus, can be efficient in project creation. Peculiar UI can be created using HTML and flask technologies.

- Python
  Websites can be used to develop the backend of a website and essential in the design of sections where users need not see. Abstraction of data is a major advantage here. Sending data and communicating with databases, URL routing, and ensuring security. Python also has comfortable compatibility with flask applications.

- Nutrition Analyzer Model
  The model is completely based on the machine learning algorithms that can classify the fruit type and

- IBM Cloud
  A predictable environment that uses hybrid cloud approach and does not compromise on foundational security. This allows a collaborative work

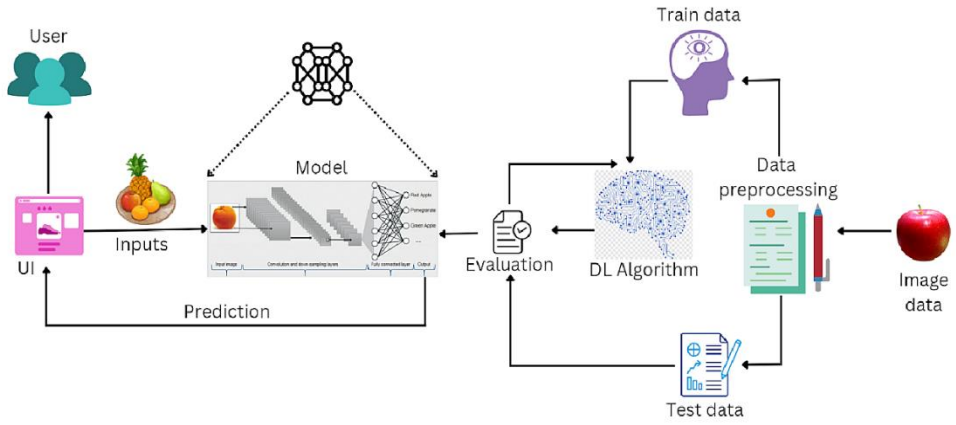
share among teammates. Red Hat OpenShift is used to build once and deploy anywhere.

Application characteristics that can be seen in the project are:

- Anaconda
  Anaconda navigator is used to launch applications and manage conda packages, environment and channels, in this project, it is used as a hub for compiling all pages to a single folder that can be accessed anywhere within the cloud.

- Jupyter notebook
  Here, the actual code is executed and this is the platform for the interface to generate the output to be generated with respect to the user's input.

Technical Architecture:



5.3 User Stories

The work assigned for users based on the role is explained in detail here.

- Customers as mobile users:
  The user will be able to access the website without any error and difficulties by providing proper backend functionality that tends to work with no network traffic and also uninterrupted internet connection must be ensured. Now, technically getting into the main project, customers can manually upload the fruit picture using the "Choose" button, which allows access to camera or browse files from the system and on click of "Classify", the result with proper nutrition content will be displayed near the uploaded picture. The classification in particular fruit like fiber, carbohydrate and fats are shown as output.

- Developers:

This developer contributes in project making by providing the interface so that the application is accessible from all the devices like mobile phone, laptop, PC, palmtops and other various devices.

- Customer care executives:
  The executives collect feedback from customers via application to improvise the website in future scope and can send the feedback to respective departments for better functioning of the application and makes the environment more comfortable for customers.

- Administrator:
  Manages and looks after the operations taking place in the application. For fault detection or network issues, rectification will be done in this sector. This section is responsible for ensuring no issues to be seen on the user's side while using the website.

- Fitness enthusiasts:
  Suggest small exercises which can provide additional improvement in health concerns along with fruit classification. The suggestions will have minimal gym equipment to make the user workout even better, as everyone might not have the tools in their place.

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority
Sprint-1		USN-2	Must be able to access fruits from drop down list to check the nutritional value contained in the fruit.	5	Medium
Sprint-1		USN-3	The classified nutritional value of fruit (which was given as input) must be displayed.	15	High
Sprint-2	Feedbacks, chatbot	USN-5	Developer should create HTML pages to access application	10	High

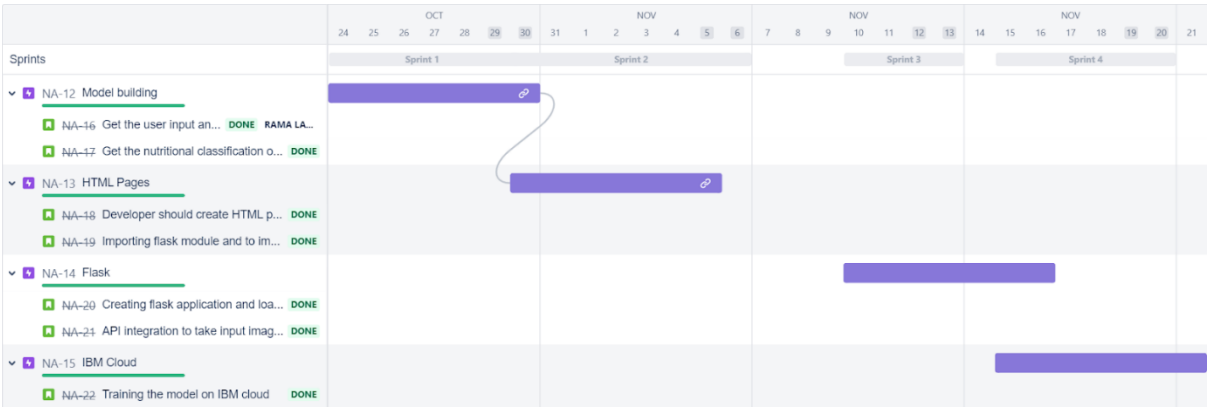
Sprint-2		USN-6	Importing flask module and to import the necessary libraries	10	High
Sprint-3		USN-4	Creating flask application and loading the python model	10	High
Sprint-3	Dashboard	USN-7	API integration to take input image from application	10	High
Sprint-4		USN-1	Training the model on IBM	15	High

6.2 Sprint Delivery Schedule

Sprint	**Total Story Points**	**Duration**	**Sprint Start Date**	**Sprint End Date (Planned)**	**Story Points Completed (as on Planned End Date)**	**Sprint Release Date (Actual)**
Sprint-1	20	6 Days	24 Oct 2022	30 Oct 2022	20	28 Oct 2022
Sprint-2	20	6 Days	30 Oct 2022	05 Nov 2022	23	04 Nov 2022
Sprint-3	20	6 Days	10 Nov 2022	16 Nov 2022	16	11 Nov 2022
Sprint-4	20	6 Days	15 Nov 2022	19 Nov 2022	18	18 Nov 2022

6.3 Report from JIRA

The sprints are split into 4 parts and each sprint have minimum 1 sub section.



7. CODING & SOLUTIONING

The dataset for the model is downloaded from the link given in the guided project section from the smartinternz website.
The steps followed in the coding parts include

- ➤ Image Preprocessing
- ➤ Model building
- ➤ Application building
- ➤ Train the model on IBM

IMAGE PREPROCESSING

The aim of pre-processing is an improvement of the image data that suppresses undesired distortions or enhances some image features relevant for further processing and analysis.

There are 4 different types of Image Pre-Processing techniques and they are listed below.

- Pixel brightness transformations/ Brightness corrections
- Geometric Transformations
- Image Filtering and Segmentation
- Fourier transform and Image restauration

In this project, image augmentation is employed to artificially expand the size of the training dataset by creating modified versions of images in the dataset. With increase in the dataset size, the model's accuracy improves. The Keras deep learning neural network library provides the capability to fit models using image data augmentation via the ImageDataGenerator class. There are five techniques in which data augmentation can be done, they are,

1. Image shifts via the width_shift_range and height_shift_range arguments.

2. The image flips via the horizontal_flip and vertical_flip arguments.
3. Image rotations via the rotation_range argument
4. Image brightness via the brightness_range argument.
5. Image zoom via the zoom_range argument.

Import The ImageDataGenerator Library

```
In [4]: from keras.preprocessing.image import ImageDataGenerator
```

Configure ImageDataGenerator Class

```
In [5]: train = ImageDataGenerator(rescale=1./255,shear_range=0.2,zoom_range=0.2,horizontal_flip=True)
        test=ImageDataGenerator(rescale=1./255)
```

Apply Image DataGenerator Functionality To Trainset And Testset

```
In [6]: x_train = train.flow_from_directory(
            r'C:\Users\Naveena\Desktop\IBM\datasets\Dataset\Nutrition Analysis\Dataset\TRAIN_SET',
            target_size=(64, 64),batch_size=5,color_mode='rgb',class_mode='sparse')
        x_test = test.flow_from_directory(
            r'C:\Users\Naveena\Desktop\IBM\datasets\Dataset\Nutrition Analysis\Dataset\TEST_SET',
            target_size=(64, 64),batch_size=5,color_mode='rgb',class_mode='sparse')

        Found 2626 images belonging to 5 classes.
        Found 1055 images belonging to 5 classes.
```

```
In [4]: print(x_train.class_indices)
        {'APPLES': 0, 'BANANA': 1, 'ORANGE': 2, 'PINEAPPLE': 3, 'WATERMELON': 4}

In [5]: print(x_test.class_indices)
        {'APPLES': 0, 'BANANA': 1, 'ORANGE': 2, 'PINEAPPLE': 3, 'WATERMELON': 4}

In [6]: from collections import Counter as c
        c(x_train .labels)
Out[6]: Counter({0: 606, 1: 445, 2: 479, 3: 621, 4: 475})
```

CONVOLUTIONAL NEURAL NETWORK – TRAINING THE MODEL

Convolutional Neural Network (CNN), is a powerful image processing deep learning type often using in computer vision that comprises an image and video recognition along with a recommender system. CNN uses a multilayer system consists of the input layer, output layer, and a hidden layer that comprises multiple convolutional layers, pooling layers, fully connected layers.

The steps involved are:

1. Importing the model building libraries
2. Initializing the model

3. Adding CNN layers
4. Adding dense layers
5. Configure the learning process
6. Train the model
7. Save the model
8. Test the model

Importing the model building libraries

In [1]:
```
import numpy as np
import tensorflow
from keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.layers import Conv2D,MaxPooling2D,Dropout
from tensorflow.keras import layers
from tensorflow.keras.layers import Dense,Flatten
from tensorflow.keras.models import Sequential
```

Keras has 2 ways to define a neural network:

- Sequential
- Function API

The Sequential class is used to define linear initializations of network layers which then, collectively, constitute a model.

CREATING THE MODEL--> Adding CNN layers

In [7]:
```
# Initializing the CNN
classifier = Sequential()
```

The input image contains three channels therefore, the input shape is set as (64,64,3). Then, two convolutional layers with activation function as “relu” and with a small filter size (3,3) followed by a max-pooling layer. Max pool layer is used to down sample the input. (Max pooling is a pooling operation that selects the maximum element from the region of the feature map covered by the filter).

```
# 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)))
```

Flatten layer flattens the input and that does not affect the batch size.

```
# 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())
```

A dense layer is a deeply connected neural network layer. It is the most common and frequently used layer. The number of neurons in the dense layer is the same as the number of classes in the training set. The neurons in the last Dense layer, use softmax activation that transforms the raw outputs of the neural network into a vector of probabilities, essentially a probability distribution over the input classes.
Keras requires loss function during the model compilation process to find errors or deviations in the learning process. Using adam optimizer, Optimization is done which is an important process that optimizes the input weights by comparing the prediction and the loss function.

Adding Dense Layers

In [8]:
```
# 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()
```

```
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 (MaxPooling2 (None, 14, 14, 32)        0
_________________________________________________________________
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
_________________________________________________________________
```

The model is trained for 20 epochs and after every epoch, the current model state is saved if the model has the least loss encountered till that time. It could be noted that the training loss decreases in almost every epoch till 20 epochs

and probably there is further scope to improve the model. fit_generator functions used to train a deep learning neural network.

```
classifier.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metrics=['accuracy'])
```

```
classifier.fit_generator(
        generator=x_train,steps_per_epoch = len(x_train),
        epochs=20, validation_data=x_test,validation_steps = len(x_test))
```

```
Epoch 1/20
526/526 [==============================] - 11s 21ms/step - loss: 0.1519 - accuracy: 0.9436 - val_loss: 0.0492 - val_accuracy:
0.9697
Epoch 2/20
526/526 [==============================] - 9s 16ms/step - loss: 0.0228 - accuracy: 0.9954 - val_loss: 0.1152 - val_accuracy:
0.9479
Epoch 3/20
526/526 [==============================] - 9s 17ms/step - loss: 0.0011 - accuracy: 0.9996 - val_loss: 0.4800 - val_accuracy:
0.9052
Epoch 4/20
526/526 [==============================] - 9s 17ms/step - loss: 0.0209 - accuracy: 0.9928 - val_loss: 0.0109 - val_accuracy:
1.0000
Epoch 5/20
526/526 [==============================] - 9s 17ms/step - loss: 8.7986e-05 - accuracy: 1.0000 - val_loss: 0.0011 - val_accura
cy: 1.0000
Epoch 6/20
526/526 [==============================] - 9s 17ms/step - loss: 7.2177e-05 - accuracy: 1.0000 - val_loss: 0.0046 - val_accura
cy: 1.0000
Epoch 7/20
526/526 [==============================] - 9s 17ms/step - loss: 2.7948e-05 - accuracy: 1.0000 - val_loss: 0.0039 - val_accura
```

The model is then saved with .h5 extension and an H5 file is a data file saved in the Hierarchical Data Format (HDF). It contains multidimensional arrays of scientific data.

```
classifier.save('nutrition.h5')
```

```
from tensorflow.keras.models import load_model
from keras.preprocessing import image
model = load_model("nutrition.h5")
```

```
img = image.load_img(r"C:\Users\Naveena\Desktop\IBM\datasets\Dataset\Nutrition Analysis\Dataset\TEST_SET\BANANA\12_100.jpg",
                     grayscale=False,target_size= (64,64))#Loading of the image
x = image.img_to_array(img)
x = np.expand_dims(x,axis = 0)
pred = model.predict_classes(x)
pred
```

```
WARNING:tensorflow:From <ipython-input-14-02bd5a61512e>:5: Sequential.predict_classes (from tensorflow.python.keras.engine.sequ
ential) is deprecated and will be removed after 2021-01-01.
Instructions for updating:
Please use instead:* `np.argmax(model.predict(x), axis=-1)`,   if your model does multi-class classification   (e.g. if it uses
a `softmax` last-layer activation).* `(model.predict(x) > 0.5).astype("int32")`,   if your model does binary classification
(e.g. if it uses a `sigmoid` last-layer activation).
```

```
array([1], dtype=int64)
```

```
index=['APPLES', 'BANANA', 'ORANGE','PINEAPPLE','WATERMELON']
result=str(index[pred[0]])
result
```

```
'BANANA'
```

```
if(result=='BANANA'):
    print('BANANA - Calories: 112, Fat: 0 grams, Protein: 1 gram and Fiber: 3 grams')
elif(result=='APPLE'):
    print('APPLE - Calories: 104, Vitamin C: 10% of the Daily Value, Carbs: 28 grams and Fiber: 5 grams')
elif(result=='PINEAPPLE'):
    print('PINEAPPLE - Calories: 83, Fat: 1.7 grams, Protein: 1 gram and Fiber: 2.3 grams')
elif(result=='ORANGE'):
    print('ORANGE - Calories: 66, Protein: 1.3 grams, Carbs: 14.8 grams and Carbs: 14.8 grams')
elif(result=='Watermelon'):
    print('WATERMELON - Calories: 46, Protein: 0.9 grams, Fat: 0.2 grams and Fiber: 0.6 grams')
```

```
BANANA - Calories: 112, Fat: 0 grams, Protein: 1 gram and Fiber: 3 grams
```

OUTPUT:


Nutrtion Image Analysis
Home
Classify
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.Nutritional 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. It ensures compliance with trade and food laws.


Nutritional Image Analysis
Home
Classify
Upload image to classify
Choose image
Food Classified is:
BANANA
[{'sugar_g': 2.6, 'fiber_g': 1.2, 'serving_size_g': 100.0, 'sodium_mg': 4, 'name': 'tomato', 'potassium_mg': 23, 'fat_saturated_g': 0.0, 'fat_total_g': 0.2, 'calories': 18.2, 'cholesterol_mg': 0, 'protein_g': 0.9, 'carbohydrates_total_g': 3.9}]

8. TESTING

8.1 TEST CASES

				Date	18-Nov-22			
				Team ID	PNT2022TMID43392			
				Project Name	Project - AI-powered Nutrition Analyzer for F			
				Maximum Marks	4 marks			
Test case ID	**Feature Type**	**Component**	**Test Scenario**	**Pre-Requisite**	**Steps To Execute**	**Expected Result**	**Actual Result**	**Status**
LoginPage_TC_001	UI	Home Page	Verify if the user is able to see the home page with the options to navigate to the	Desktop, Internet connectivity, local browser	1. Enter URL and click go 2. Verify if the home page is opened or not	Home page should be opened	Working as expected	Pass
LoginPage_TC_002	UI	Home Page	Verify the UI elements in the home page	Desktop, Internet connectivity, local browser	1.Enter URL and click go 2.Click on the classify option and verify the UI elaments like the to classify button. Check if you can input the image	The application should show below UI elements: 1. Background image 2. To view the image option and the classify option	Working as expected	Pass
LoginPage_TC_003	UI	Home Page	Check if the UI elements are displayed properly in different screen sizes	Desktop, Internet connectivity, local browser	1. Enter URL and click go 2. Resize the screen and verify	The home pages should be displayed properly in all sizes	The web pages are not displayed properly in different sizes	Fail
LoginPage_TC_004	Funotional	Home page	Check if the user is able to load the image from their file system	Desktop, Internet connectivity, local browser	1.Enter URL and click go 2. Click on the classify page 3. Click the choose image button to input the image desired	Must be able to load the input image from the desktop to the web application	Working as expected	Pass
Backend_TC_001	Funotional	Backend	Check if all the routes are working properly	Desktop, Internet connectivity, local browser, input image	1. Enter the URL and click go 2. Click on the choose image button 3. Choose the desired image to be recognised 4. Click on the classify button	The user must be able to navigate to all the pages and could view the results	Working as expected	Pass
Model_TC_001	Funotional	Model	Check if the model can handle various image sizes	Desktop, Internet connectivity, input image, local browser	1. Enter the URL and click go 2. Click on the choose image button 3. Choose the desired image to be recognized	The model should rescale the image and predict the results	Working as expected	Pass
Model_TC_002	Funotional	Model	Check if the model predicts the fruit	Desktop, Internet connectivity, input image, local browser	1. Enter the url and click go 2. Click on the choose image button 3. Choose the desired image to be recognised	The result should be displayed	Working as expected	Pass

8.2 USER ACCEPTANCE TESTING

1. Purpose of document
2. Defect analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

RESOLUTION	SEVERITY 1	SEVERITY 2	SEVERITY 3	SEVERITY 4	SUBTOTAL
By Design	9	5	3	2	19
Duplicate	0	0	4	0	4
External	3	2	0	1	6
Fixed	10	4	3	19	36
Not Reproduced	0	0	1	1	2
Skipped	0	0	1	0	1
Won't Fix	0	4	1	2	7
Totals	22	15	13	25	75

3. Test Case analysis:

This report shows the number of test cases that have passed, failed, and untested.

Section	Total Cases	Not tested	Fail	Pass
Home page	2	0	0	2
Classify page	5	0	1	4

Model	4	0	0	4
Result page	2	0	0	2

9. RESULT:

9.1 Performance Metrics

➤ MODEL SUMMARY

```
classifier.summary()
```

```
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 (MaxPooling2 (None, 14, 14, 32)        0
_________________________________________________________________
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
_________________________________________________________________
```

➤ ACCURACY

Values: Training Accuracy – 0.995245

Validation Accuracy – 0.98577

```
classifier.fit_generator(
        generator=x_train,steps_per_epoch = len(x_train),
        epochs=20, validation_data=x_test,validation_steps = len(x_test))
```

```
Epoch 1/20
526/526 [==============================] - 11s 21ms/step - loss: 0.1519 - accuracy: 0.9436 - val_loss: 0.0492 - val_accuracy:
0.9697
Epoch 2/20
526/526 [==============================] - 9s 16ms/step - loss: 0.0228 - accuracy: 0.9954 - val_loss: 0.1152 - val_accuracy:
0.9479
Epoch 3/20
526/526 [==============================] - 9s 17ms/step - loss: 0.0011 - accuracy: 0.9996 - val_loss: 0.4800 - val_accuracy:
0.9052
Epoch 4/20
526/526 [==============================] - 9s 17ms/step - loss: 0.0209 - accuracy: 0.9928 - val_loss: 0.0109 - val_accuracy:
1.0000
Epoch 5/20
526/526 [==============================] - 9s 17ms/step - loss: 8.7986e-05 - accuracy: 1.0000 - val_loss: 0.0011 - val_accura
cy: 1.0000
Epoch 6/20
526/526 [==============================] - 9s 17ms/step - loss: 7.2177e-05 - accuracy: 1.0000 - val_loss: 0.0046 - val_accura
cy: 1.0000
Epoch 7/20
526/526 [==============================] - 9s 17ms/step - loss: 2.7948e-05 - accuracy: 1.0000 - val_loss: 0.0039 - val_accura
```

10. ADVANTAGES & DISADVANTAGES

This nutrition analyser is AI powered and would be useful for the world which grows more fitness-conscious with passing time, the demand for technological solutions to cater to this burgeoning demand is diversifying. Calorie intake in fruits can be analyzed and in most cases, what we see is that these platforms act as a data repository where while providing real-time information to its users, it also makes available to numerous clients who work in this field for a determined rate. The quality of nutrition analyzed is high for each fruit with improved accuracy rate. As fruits are globally more or less similar, it's easier for the model to give the report as output. Image recognition is easier when the dataset is sufficient to train the model.

The project is restricted only to fruits and everytime new picture must be uploaded, which are minor disadvantages.

11. CONCLUSION

This project is used for analyzing the nutritional types and level in fruits. The UI is made with the most user friendly and source of error is considered minimal. Good nutrition not only betters physical health but also reduces susceptibility to disease. The main expected users are working people and teenagers as they probably consume less fruits.

12. FUTURE SCOPE

This project can be further improved in terms of other food items, starting from vegetables to native diets. STT can also be used for food as input. Capturing a fruit from a video recording can also be done. This application will not just be restricted to analyze the nutritional content of fruit, but also recommend alternative fruit diets and also suggest basic exercise without any gym equipment to make it easier for all customers to satisfy their requirements.

13. APPENDIX

Source code - Application (App.py)

```python
from flask import Flask,render_template,request
import os
import numpy as np
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
import requests


app = Flask(__name__,template_folder="templates")
model=load_model('nutrition.h5')
print("Loaded model from disk")


@app.route('/')
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
```

```python
        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":"tomato"}
    headers = {
        "X-RapidAPI-Key": "645d6678d0msh5f973fb3bf16e8dp1cc494jsn314e47b01d11",
        "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__":
    app.run(debug=False)
```

Output after the execution of app.py

```
C:\Users\Naveena\Desktop\IBM\datasets\Dataset\Nutrition Analysis\Dataset\Flask>exit /B 0
PS C:\Users\Naveena\Desktop\IBM\datasets\Dataset\Nutrition Analysis\Dataset\Flask> & D:/Anaconda/Newfolder/envs/new/python.exe "c:/Users/Naveena/Desktop/IBM/datasets/Dataset/Nutrition Analysis/Dataset/Flask/app.py"
2022-11-19 16:04:43.896246: I tensorflow/core/platform/cpu_feature_guard.cc:142] This TensorFlow binary is optimized with oneAPI Deep Neural Network Library (oneDNN)to use the following CPU instructions in performance-critical operations:  AVX AVX2
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.
Loaded model from disk
 * Serving Flask app 'app' (lazy loading)
 * Environment: production
   WARNING: This is a development server. Do not use it in a production deployment.
   Use a production WSGI server instead.
 * Debug mode: off
 * Running on http://127.0.0.1:5000/ (Press CTRL+C to quit)
```

0.html

templates > 0.html

```
<html lang="en" dir="ltr">
<head>
<style>

</style>
        <meta charset="utf-8">
        <title>Nutrition Image Analysis</title>
        <link rel="shortcut icon" href="{{ url_for('static', filename='diabetes-favicon.ico') }}">
        <link rel="stylesheet" type="text/css" href="{{ url_for('static', filename='style.css') }}">
        <script src="https://kit.fontawesome.com/5f3f547070.js" crossorigin="anonymous"></script>
        <link href="https://fonts.googleapis.com/css2?family=Pacifico&display=swap" rel="stylesheet">
    </head>
        <div class="results">
                <p style="padding-top: 150px; color:blue;"><h4 style="color:blue;">Food Classified is: <h4><b><h4 style="color:red;"><u>{

        </div>
        <br>
        <br>

    </div>
    </body>
</html>
```

Home.html

templates > home.html

```
<!DOCTYPE html>
<html>
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <meta http-equiv="X-UA-Compatible" content="ie=edge">
    <title>Home</title>
    <link href="https://cdn.bootcss.com/bootstrap/4.0.0/css/bootstrap.min.css" rel="stylesheet">
    <script src="https://cdn.bootcss.com/popper.js/1.12.9/umd/popper.min.js"></script>
    <script src="https://cdn.bootcss.com/jquery/3.3.1/jquery.min.js"></script>
    <script src="https://cdn.bootcss.com/bootstrap/4.0.0/js/bootstrap.min.js"></script>
    <link href="{{ url_for('static', filename='css/main.css') }}" rel="stylesheet">
<style>
body
{
    background-image: url("https://st2.depositphotos.com/4043853/5924/v/950/depositphotos_59247467-stock-illustration-mixed-fruits-border-frame.jpg");
    background-size: cover;
}
.bar
{
margin: 0px;
padding:20px;
background-color:white;
opacity:0.6;
color:rgb(0, 0, 0);
font-family:'Roboto',sans-serif;
font-style: italic;
border-radius:20px;
font-size:25px;
}
h3
{
margin: 0px;
padding:20px;
background-color:#9ACD32;
width: 800px;
opacity:0.6;
```

templates > home.html

```
<!DOCTYPE html>
<html>
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <meta http-equiv="X-UA-Compatible" content="ie=edge">
    <title>Home</title>
    <link href="https://cdn.bootcss.com/bootstrap/4.0.0/css/bootstrap.min.css" rel="stylesheet">
    <script src="https://cdn.bootcss.com/popper.js/1.12.9/umd/popper.min.js"></script>
    <script src="https://cdn.bootcss.com/jquery/3.3.1/jquery.min.js"></script>
    <script src="https://cdn.bootcss.com/bootstrap/4.0.0/js/bootstrap.min.js"></script>
    <link href="{{ url_for('static', filename='css/main.css') }}" rel="stylesheet">
<style>
body
{
    background-image: url("https://st2.depositphotos.com/4043853/5924/v/950/depositphotos_59247467-stock-illustration-mixed-fruits-border-frame.jpg");
    background-size: cover;
}
.bar
{
margin: 0px;
padding:20px;
background-color:white;
opacity:0.6;
color:rgb(0, 0, 0);
font-family:'Roboto',sans-serif;
font-style: italic;
border-radius:20px;
font-size:25px;
}
h3
{
margin: 0px;
padding:20px;
background-color:#9ACD32;
width: 800px;
opacity:0.6;
```

templates > home.html

```
<!DOCTYPE html>
<html>
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <meta http-equiv="X-UA-Compatible" content="ie=edge">
    <title>Home</title>
    <link href="https://cdn.bootcss.com/bootstrap/4.0.0/css/bootstrap.min.css" rel="stylesheet">
    <script src="https://cdn.bootcss.com/popper.js/1.12.9/umd/popper.min.js"></script>
    <script src="https://cdn.bootcss.com/jquery/3.3.1/jquery.min.js"></script>
    <script src="https://cdn.bootcss.com/bootstrap/4.0.0/js/bootstrap.min.js"></script>
    <link href="{{ url_for('static', filename='css/main.css') }}" rel="stylesheet">
<style>
body
{
    background-image: url("https://st2.depositphotos.com/4043853/5924/v/950/depositphotos_59247467-stock-illustration-mixed-fruits-border-frame.jpg");
    background-size: cover;
}
.bar
{
margin: 0px;
padding:20px;
background-color:white;
opacity:0.6;
color:rgb(0, 0, 0);
font-family:'Roboto',sans-serif;
font-style: italic;
border-radius:20px;
font-size:25px;
}
h3
{
margin: 0px;
padding:20px;
background-color:#9ACD32;
width: 800px;
opacity:0.6;
color:#000000;
font-family:'Roboto',sans-serif;
font-style: italic;
border-radius:20px;
font-size:25px;
}
a
{
color:rgb(12, 10, 10);
float:right;
text-decoration:none;
font-style:normal;
padding-right:20px;
}
a:hover{
background-color:black;
color:white;
border-radius:15px;
font-size:30px;
padding-left:10px;
}
.div1{
    background-color: rgb(18, 1, 1);
    width: 500px;
    border: 10px solid peach;
    padding: 20px;
    margin: 20px;
    height: 500px;
}
```

```
.header { position: relative;
        top:0;
        margin:0px;
        z-index: 1;
        left: 0px;
        right: 0px;
        position: fixed;
        background-color:#7bec0ad4 ;
        color: white;
        box-shadow: 0px 8px 4px #2ce11cc1;
        overflow: hidden;
        padding-left:20px;
        font-family: 'Josefin Sans'
        font-size: 2vw;
        width: 100%;
        height:8%;
        text-align: center;
      }
      .topnav {
    overflow: hidden;
    background-color: #FCAD98;
  }

.topnav-right a {
    float: left;
    color: black;
    text-align: center;
    padding: 14px 16px;
    text-decoration: none;
    font-size: 22px;
  }

.topnav-right a:hover {
    background-color: #2ce11cc0;
    color: black;
  }

```

```

.topnav-right a.active {
    background-color: #16f72da2;
    color: black;
  }

.topnav-right {
    float: right;
    padding-right:100px;
  }
  </style>
  </head>
  <body>

  <div class="header">
  <div style="width:50%;float:left;font-size:2vw;text-align:left;color:black; padding-top:1%;padding-left:5%;">Nutrtion Image Analysis</div>
    <div class="topnav-right"style="padding-top:0.5%;">

      <a class="active" href="{{ url_for('home')}}">Home</a>
      <a   href="{{ url_for('image1')}}">Classify</a>

    </div>
  </div>
  </div>
  <br>
  <br>
  <br>
  <br>
  <br>
  <br>
  <br>
  <br>
  <br>
  <h1>

  <center>


```

```
<h3>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.Nutritional 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. It ensures compliance with trade and food laws.</h3>

</center>


</h1>
</body>
</html>
```

Image.html

templates > image.html

```
{% extends "imageprediction.html" %} {% block content %}
<div style="float:left">
<br>
<br>
<h5><font color="black" size="3" font-family="sans-serif"><b>Upload image to classify</b></font></h5><br><br>

<div>
    <form id="upload-file" method="post" enctype="multipart/form-data">
      <label for="imageUpload" class="upload-label">
          Choose image<br>
      </label>
      <input type="file" name="file" id="imageUpload" accept=".png, .jpg, .jpeg">
    </form>

  <center> <div class="image-section" style="display:none;">
      <div class="img-preview">
          <div id="imagePreview">
          </div></center>
      </div>
      <center><div>
          <button type="button" class="btn btn-primary btn-lg " id="btn-predict">Classify</button>
      </center></div>
    </div>

    <div class="loader" style="display:none;margin-left: 450px;"></div>

    <h3 id="result">

        <span><p style="padding-top: 25px;"><h4>Food Classified is : <h4><b><u>{{showcase}}{{showcase1}}</p> </span>
    </h3>

</div>
</div>
{% endblock %}
```

Image prediction.html

templates > imageprediction.html

```
<!DOCTYPE html>
<html>
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <meta http-equiv="X-UA-Compatible" content="ie=edge">
    <title>Predict</title>
    <link href="https://cdn.bootcss.com/bootstrap/4.0.0/css/bootstrap.min.css" rel="stylesheet">
    <script src="https://cdn.bootcss.com/popper.js/1.12.9/umd/popper.min.js"></script>
    <script src="https://cdn.bootcss.com/jquery/3.3.1/jquery.min.js"></script>
    <script src="https://cdn.bootcss.com/bootstrap/4.0.0/js/bootstrap.min.js"></script>
    <link href="{{ url_for('static', filename='css/main.css') }}" rel="stylesheet">
<style>
body
{
    background-image: url('https://img.freepik.com/free-photo/assortment-citrus-fruits_144627-22506.jpg?w=2000');
    background-size: cover;
}
.bar
{
margin: 0px;
padding:20px;
background-color:white;
opacity:0.6;
color:black;
font-family:'Roboto',sans-serif;
font-style: italic;
border-radius:20px;
font-size:25px;
}
a
{
color:grey;
float:right;
text-decoration:none;
font-style:normal;
padding-right:20px;
}
a:hover{
background-color:black;
color:white;
border-radius:15px;0
font-size:30px;
padding-left:10px;
}
.div1{
  background-color: lightgrey;
  width: 500px;
  border: 10px solid peach;
  padding: 20px;
  margin: 20px;
  height: 500px;
}



.header { position: relative;
      top:0;
      margin:0px;
      z-index: 1;
      left: 0px;
      right: 0px;
      position: fixed;
      background-color: #7bec0ad4
      color: white;
      box-shadow: 0px 8px 4px #2ce11cc1;
      overflow: hidden;
      padding-left:20px;
      font-family: 'Josefin Sans';
      font-size: 2vw;
      width: 100%;
      height:8%;
```

```
        text-align: center;
      }
      .topnav {
    overflow: hidden;
    background-color: #FCAD98;
  }

  .topnav-right a {
    float: left;
    color: black;
    text-align: center;
    padding: 14px 16px;
    text-decoration: none;
    font-size: 22px;
  }

  .topnav-right a:hover {
    background-color: #2ce11cc0;
            color: black;
  }

  .topnav-right a.active {
    background-color: #16f72da2;
            color: black;
  }

  .topnav-right {
    float: right;
    padding-right:100px;
  }
  </style>
  </head>
  <body>
  <div class="header">
  <div style="width:50%;float:left;font-size:2vw;text-align:left;color:black; padding-top:1%;padding-left:5%;"><b><center>Nutritional Image
    <div class="topnav-right"style="padding-top:0.5%;">
```

```
      <a href="{{ url_for('home')}}">Home</a>
      <a  class="active" href="{{ url_for('image1')}}">Classify</a>
    </div>
  </div>
  <br>


  </div>
  <div class="container">
        <center>
  <div id="content" style="margin-top:2em">{% block content %}{% endblock %}</div></center>
      </div>
  </body>

  <footer>
      <script src="{{ url_for('static', filename='js/main.js') }}" type="text/javascript"></script>
  </footer>

  </html>
```

GITHUB LINK:

https://github.com/IBM-EPBL/IBM-Project-42335-1660660018

AUDIO LINK:

https://drive.google.com/file/d/18eyGjQ_vb30OHprVkHE8OfW02mldS6qV/view?usp=sharing

VIDEO LINK:

https://drive.google.com/file/d/1Klh_M2VW4xWkLoxoVn0gvHuCC8vGRioo/view?usp=share_link