

AI-Powered Nutrition Analyzer For Fitness Enthusiasts

**Vel Tech Multi Tech. Dr. Rangarajan Dr. Sakunthala Engineering
College**

Nalaiya Thiran - Project Report

Team ID: PNT2022TMID22365

Loakash K
Jagadesh J
Arvind E
Sathish Kumar v

TABLE OF CONTENTS

Chapter	Title	Page. No
1	INTRODUCTION	4
	1.1 Project Overview	4
	1.2 Purpose	4
2	LITERATURE SURVEY	4
	2.1 Existing problem	4
	2.2 References	4
	2.3 Problem Statement Definition	5
3	IDEATION & PROPOSED SOLUTION	5
	3.1 Empathy Map Canvas	5
	3.2 Ideation & Brainstorming	6
	3.3 Proposed Solution	7
	3.4 Problem Solution fit	8
4	REQUIREMENT ANALYSIS	9
	4.1 Functional requirement	9
	4.2 Non-Functional requirements	12
5	PROJECT DESIGN	13
	5.1 Data Flow Diagrams	13
	5.2 Solution & Technical Architecture	15
	5.3 User Stories	17
6	PROJECT PLANNING & SCHEDULING	18
	6.1 Sprint Planning & Estimation	18
	6.2 Sprint Delivery Schedule	19
	6.3 Reports from JIRA	19
7	CODING & SOLUTIONING	20
	7.1 Feature 1	20
	7.2 Feature 2	22
	7.3 Feature 3	24
8	TESTING	26
	8.1 Test Cases	26
	8.2 User Acceptance Testing	27
9	RESULTS	27
	9.1 Performance Metrics	27
10	ADVANTAGES & DISADVANTAGES	31

11	CONCLUSION	32
12	FUTURE SCOPE	32
13	APPENDIX	32
	Source Code	34
	GitHub & Project Demo Link	34

1. INTRODUCTION

Project Overview

Food is the basis of human life and is the subject of many health conventions. Today, new nutrition assessment and analysis tools are opening up more opportunities to help people understand their daily diet, explore nutritional patterns, and maintain a healthy diet. Nutritional analysis is the process of determining the nutritional composition of foods. It is an important part of analytical chemistry that provides information on the chemical composition, processing, quality control and contamination of foods.

The main objective of the project is to create a model that is used for classifying fruits depending on various features like color, shape, texture, etc. Here, the user can capture images of different fruits and then the image will be sent to the trained Model. The model analyzes the image and determines the nutrition based on the fruit such as (sugar, fiber, protein, calories, etc.).

PURPOSE

The main aim of the project is to building a model which is used for classifying the fruit depends 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 the trained model. The model analyses the image and detect the nutrition based on the fruits like(Sugar, Fibre, Protein,Calories, etc.).

2. LITERATURE SURVEY

Existing problem

Neutrino provides nutrition-based data services and analytics to its users and aims to become the leading source of nutrition-related platform. The platform uses NLP and mathematical models from optimization theory as well as predictive analytics to enable individualized data compilation. The app relies on artificial intelligence to generate its own data related to the AI-powered smart calorie counter. Their artificial intelligence learns individual tastes, preferences and body type. It's all wrapped up in comprehensive nutrition and activity tracking.

References

1. Published on April 8, 2019 From Gynaecology to Data Science : The journey of Dr Nitin Paranjape. Analyticsindiamag.com, Akshaya Asokan.
2. Melina cote and Benoit Lamarche , Applied Physiology , Nutrition and Metabolism 15
3. Deloitte(2017) the hospital of the future URL www.deloitte.com/us/globalhospital-of-the-future (accessed August 9,2019)

Problem Statement Definition

The main objective of the project is to create a model that is used for classifying fruits depending on various features like color, shape, texture, etc. Here, the user can capture images of different fruits and then the image will be sent to the trained Model. The model analyzes the image and determines the nutrition based on the fruit such as (sugar, fiber, protein, calories, etc.).

3. IDEATION & PROPOSED SOLUTION

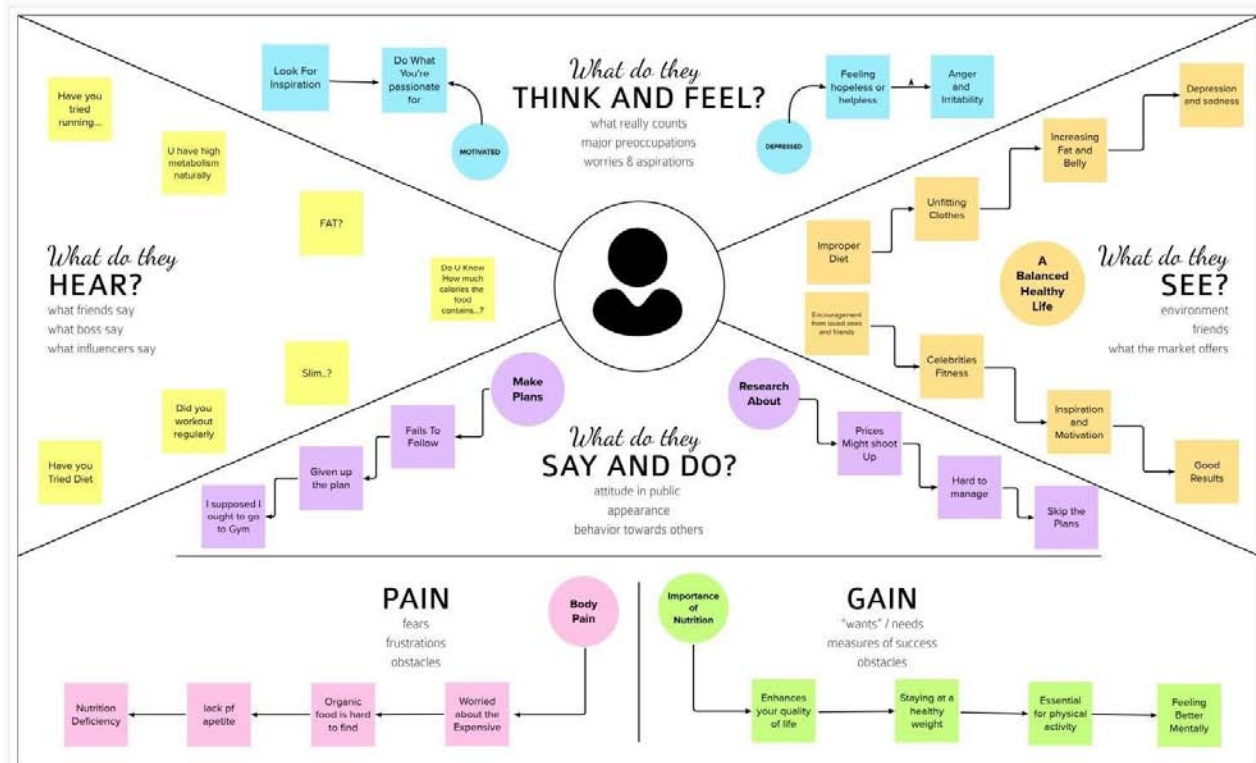
Empathy Map Canvas

Empathy Map Canvas

Gain insight and understanding on solving customer problems.

1

Build empathy and keep your focus on the user by putting yourself in their shoes.



Share your feedback

Ideation & Brainstorming

Brainstorm & idea prioritization

Use this template in your own brainstorming sessions to your team. Use worksheets that encourage your team to brainstorm ideas and then prioritize them. You'll find all the tools you need in the same place.

Before you collaborate:

- A little bit of preparation goes a long way. Make sure you have a clear understanding of the problem you're trying to solve.
- Get everyone on the same page.

Define your problem statement:

What problem are you trying to solve? Make your problem as clear as possible. The clearer the problem, the easier it is to solve.

Brainstorm:

Brainstorm ideas that come to mind. Write down your problem statement.

Group ideas:

Now it's time to group your ideas. Write down your ideas in the boxes. Group them into categories. Write down your ideas in the boxes. Group them into categories.

Prioritize:

Now it's time to prioritize your ideas. Write down your ideas in the boxes. Group them into categories. Write down your ideas in the boxes. Group them into categories.

NUTRITIONAL

DELICIOUS DIET MEAL RECIPES.	PERSONALIZED NUTRITION.
KETO DIET.	CLIMATE FRIENDLY SUSTAINABLE ENERGY DIET PLAN.
BOXERCISE.	FOOD AND ACTIVITY LEVEL MAINTENANCE.
DEEP KNOWLEDGE ABOUT NUTRITIONAL EDUCATION.	CONVENIENCE: FOOD AND HEALTHY TAKE AWAY MEALS.

WORKOUT

CALISTHENICS TRAINING.	POWER LIFTING TRAINING.
AEROBICS TRAININGS.	CROSS FIT RESISTANCE TRAINING.
TRACK CYCLIST TRAINING.	FUN FITNESS GAME.
TAKE YOUR DOG TO LONG WALK.	PRACTICE YOGA.

PROGRAMS

AWARENESS FOR HEALTHY EATING.	HEALTHY MEAL KIT DELIVERY SERVICE.
CLARITY ON DIET MYTHS AND NUTRITIONAL FAKE NEWS.	ONLINE NUTRITION COUNSELING.
STRENGTH WARS. (CHALLENGES)	FITNESS BLOGS.
DEEP KNOWLEDGE ABOUT NUTRITIONAL EDUCATION.	CUSTOMISED GYM WEARS.

Proposed Solution

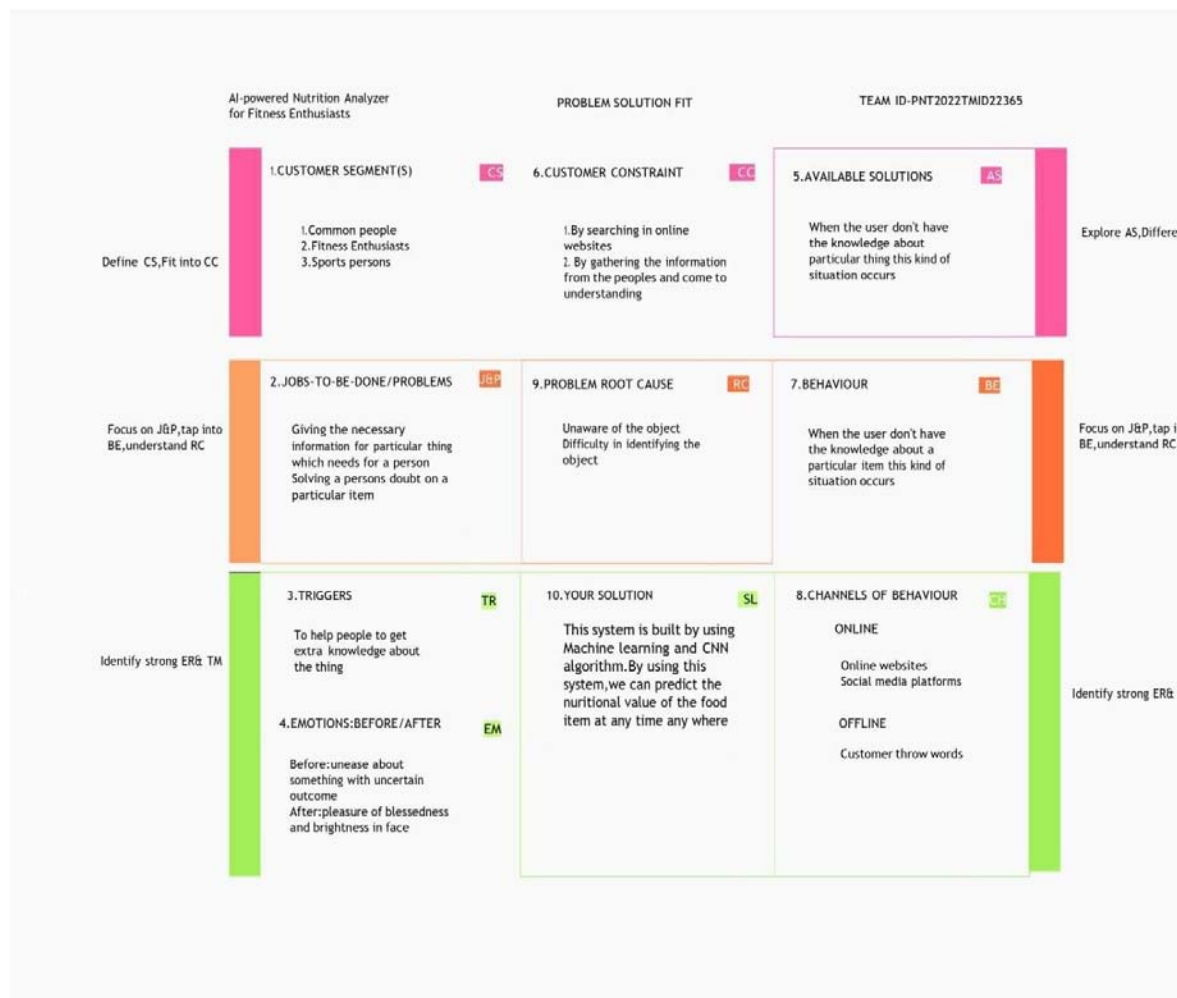
S. No.	Parameter	Description
1.	PROPOSED SOLUTION	The user needs information about the nutritional values of different types of food. Here the user can capture the images of different fruits and then the image will be analysed with the trained model. The model analyses the image and lists out the nutrients present in the fruit like sugar, vitamins, minerals, protein etc.
2.	FEASIBILITY OF IDEA	The idea of this application is that the user can capture the images of different fruits and vegetables, and then the image will be sent to the trained model. It detects the nutrition on fruits. The above idea is achieved by using the Convolution Neural Network (CNN).
3.	NOVELTY	Easier prediction of calorie utilization, preparing healthy diet and improve customer satisfaction by providing information about the food items. It provides for a personalized dietary requirement for individuals who have limited preferences while choosing food.
4.	SOCIAL IMPACT	Acquire knowledge & information about nutrition which is present in each fruit for their fitness.
5.	BUSINESS MODEL	<ul style="list-style-type: none">• Key Partners are supporting organization and fitness enthusiasts.• Key Activities are done as prediction, suggestion for calorie consumption and healthy life suggestion.• Showing advertisements and promoting certain brands by collaborating with Google AdSense.• Channels are email, mobile, helpline and health care.• Promoting in Social media.
6.	SCALABILITY	Every Customer must get Healthy Life and Proper Diet Maintenance based on the Healthy Measure and Calorie prediction. Also suggest the feedback to maximize the Application usage. Every user can easily access our product from their smartphones for free and easy to understand interface.

Problem Solution fit :

Problem-Solution Fit simply means that you have found a problem with your customer and that the solution you have implemented for them actually solves the customer's problem. It helps entrepreneurs, marketers and corporate innovators identify patterns of behavior

Purpose:

- Solve complex problems in a way that fits your customers' situation.
- Achieve faster success and increase adoption of your solution by leveraging existing media and behavioral channels.
- Enhance your communication and marketing strategy with the right triggers and messages.
- Increase touch points with your company by finding the right fit for problem behaviors and building trust by addressing frequent annoyances or urgent or costly issues.

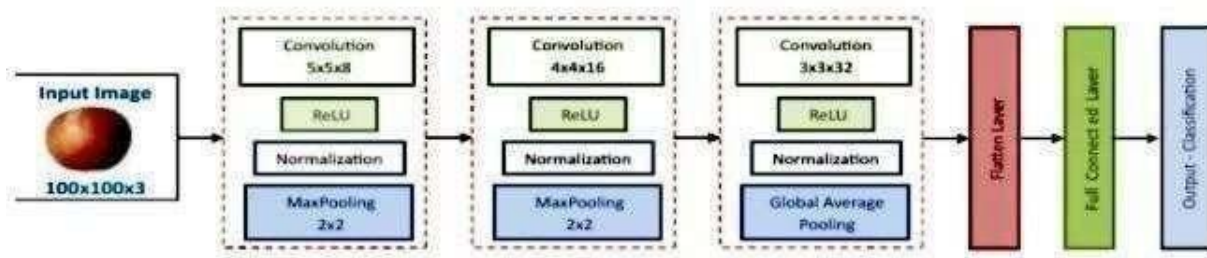


4. REQUIREMENT ANALYSIS

Functional requirement:

- It will generate a diet plan and also track the user's health to classify the disease category and create a diet plan. It will also reduce the cost of consulting a nutritionist.
- The task of food detection/classification is not as easy as it seems. All possible options related to a given image.
- Image classification, object detection, segmentation, face recognition.
- Crystal structure classification using a convolutional neural network
- Nutrition is vital for the growth of the human body. Nutritional analysis ensures that the food meets the appropriate vitamin and mineral requirements, and the nutrition examination of the food helps to understand the proportion of fat, dilution of carbohydrates, protein, fiber, sugar, etc. Another thing to keep in mind is not to exceed our daily requirements for calorie
- Computer Aided Nutrition for Food Image Recognition – To solve this problem, a completely new Convolutional Neural Network (CNN) based food identification system was created. Created as described in this study. We applied our proposed strategy on two real food datasets.
- Here the user can capture images of different fruits and then the image will be sent to the trained model. The model analyzes the image and detects nutrition based on the fruit as (sugar, fiber, protein, calories, etc.)
- The best solution for working out at home This AI fitness software is designed with individual training regimens for each individual. It started out as "gym-only software" but has now refined its system to meet "home fitness" expectations.
- You take a picture, dial in information such as whether you're having breakfast or lunch, add a quick text label, and the app estimates the calorie content.
- This software worked with IBM's natural language capability to provide 24-hour assistance and dietary recommendations.

For Example:



- Comparison of the proposed model with conventional models shows that the results of this model are extremely good and promising for use in real applications.
- This kind of higher accuracy and precision will enhance the general effectiveness of the machine in recognizing fruits more adequately.
- The general model for the need for protein in the diet (as with any nutrient) defines the requirement in terms of the organism's needs,
- i.e. metabolic demands and the dietary amount that satisfies these needs, i.e. utilization efficiency, i.e.: $\text{dietary requirement} = \text{metabolic need} / \text{utilization efficiency}$.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	USER REGISTRATION	<p>Interacting the user through web interface and automated voice to answer the user queries and to guide them in a proper way to maintain their fitness.</p> <ul style="list-style-type: none"> ● There will be separate and special features for the registered user to get personalized and well defined advice and good practice lectures to maintain their fitness.
FR-2	USER MANAGEMENT	The application gives the ability to ask questions about a problem in the fitness groups, through which they can work effectively.
FR-3	USER SATISFYING	The satisfaction of each user is a must, so UI/UX should be more than enough to engage the user in the platform and the performance of the application should be optimized in order to keep every user for a long time.
FR-4	USER ENGAGEMENT	The user should be engaged in the application at least Once a day to get notified about the latest and good practice on fitness which is recommended by the backend model.

Non-Functional requirements

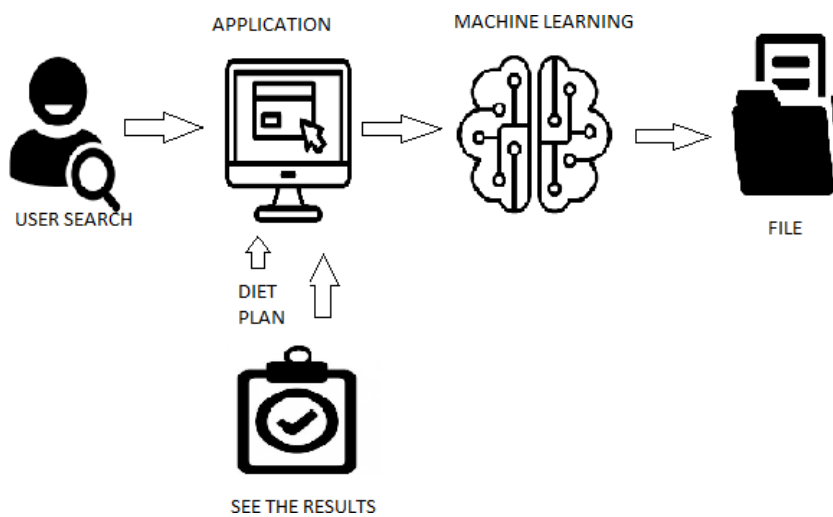
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	<ul style="list-style-type: none">• It should be user friendly and comfortable.• The results should be self explanatory so that it can be understood by common people.• It should be simple and easy to use.
NFR-2	Security	<ul style="list-style-type: none">• Users information must be maintained secretly.• AI powered nutrition analyzer for fitness should contain more security in which our data which entered or maintained should be more security.
NFR-3	Reliability	<ul style="list-style-type: none">• Fault less application.• A piece of software operating without failure.• The website load time is not more than one second for users.
NFR-4	Performance	<ul style="list-style-type: none">• It should provide Reliability, Scalability, Security and Usability.• Fast and quick analyzation of food images• Occupation less storage.
NFR-5	Availability	<ul style="list-style-type: none">• A user can access the resource at free of cost, they can collect the information which they required.• User Friendly.
NFR-6	Scalability	Accessibility should be as much as scalable, in order to increase the number of users based on their interest.

5. PROJECT DESIGN

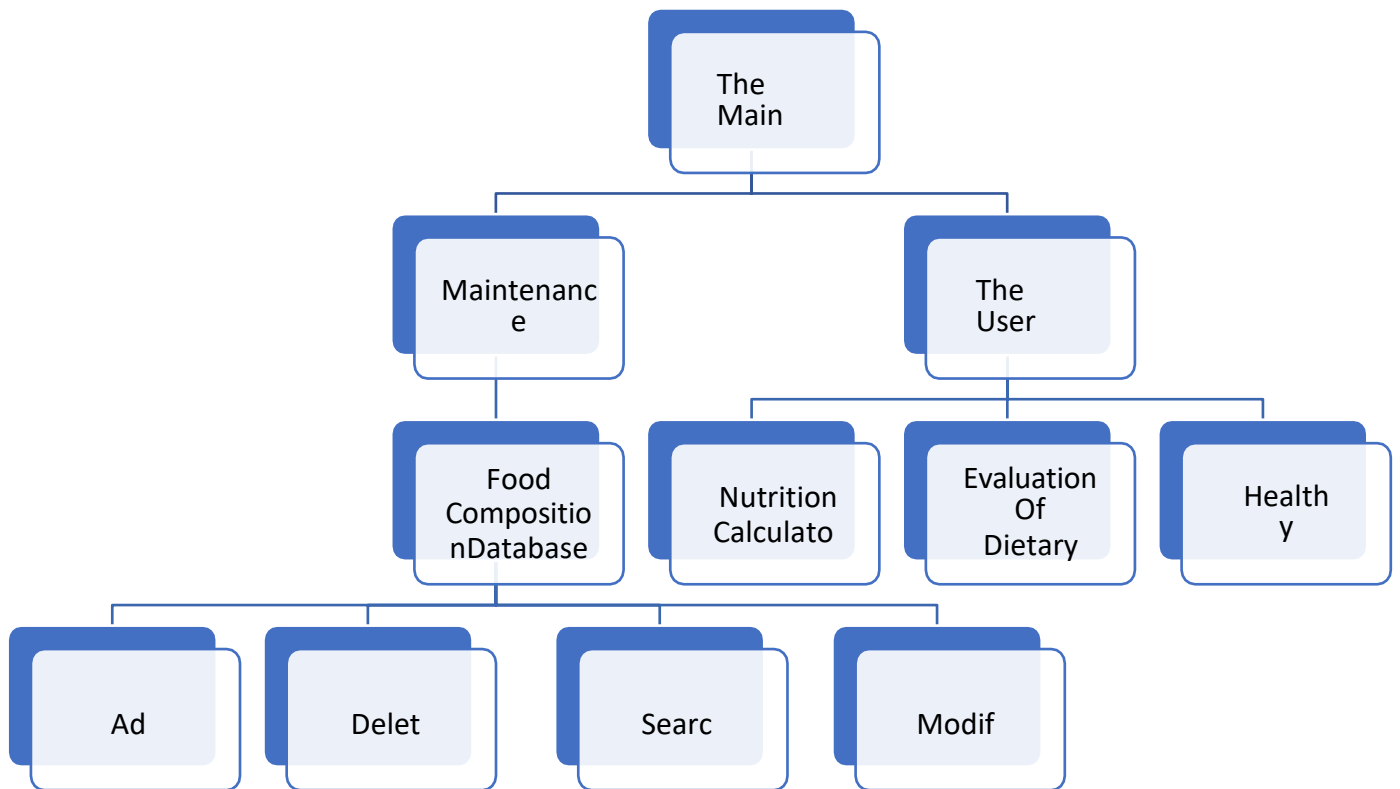
Data Flow Diagrams :

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.

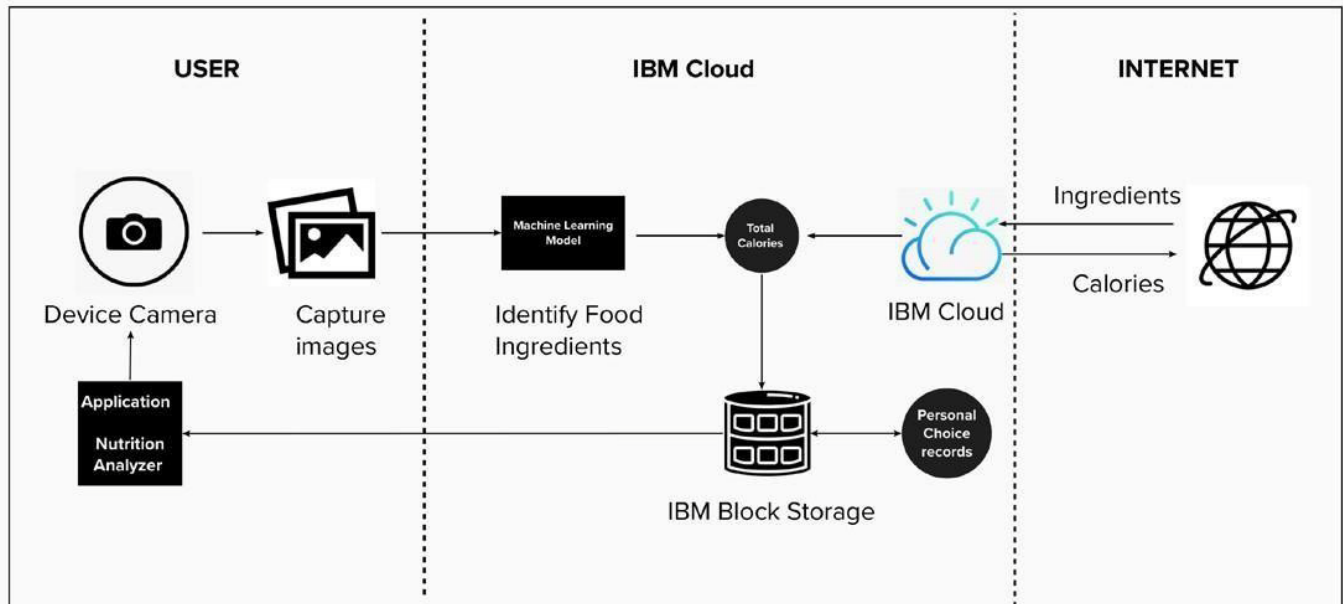
Simplified Data Flow Diagram:

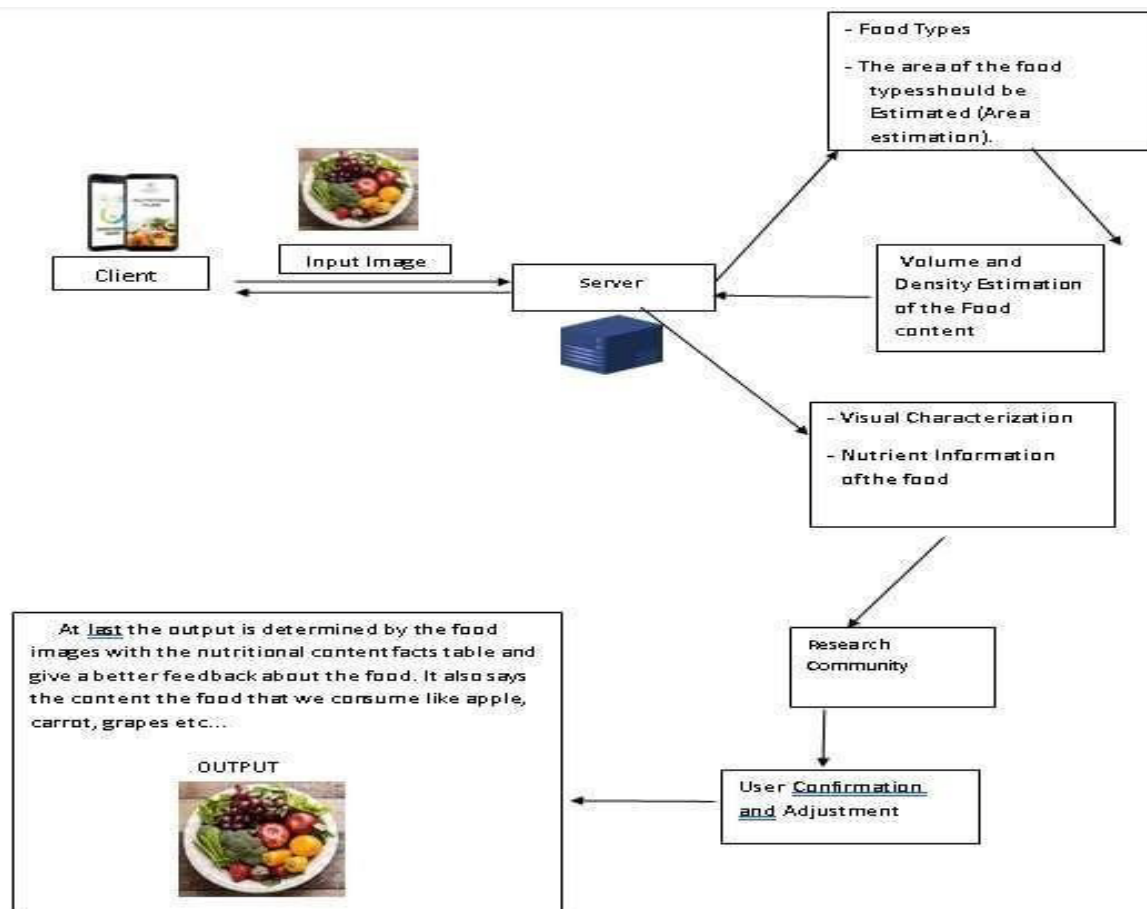


Data Flow Diagram:



Solution & Technical Architecture





User Stories

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Application Building	USN-1	Now that we have trained our model, let us build our flask application which will be running in our local browser with a user interface. In the flask application, the input parameters are taken from the HTML page. These factors are then given to the model to predict the type of food and to know the nutrition content in it. In order to know the nutrition content we will be using an API in this project.	2	High	Sathish Kumar JAGADESH ARVIND LOAKASH
Sprint-2	Train the model on IBM and Image Preprocessing	USN-1	In this milestone, we will register in the IBM cloud and Train the Model in the cloud. Finally we will build a deep learning model. The ImageDataGenerator accepts the original data, randomly transforms it, and returns only the new, transformed data.	2		Sathish Kumar JAGADESH ARVIND LOAKASH
Sprint-3	Data selection	USN-1	we will be improving the image data that suppresses unwilling distortions or enhances some image features important for further processing, although performing some geometric transformations of images like rotation, scaling, translation, etc.	2	High	Sathish Kumar JAGADESH ARVIND LOAKASH
Sprint-4	Model Building	USN-1	Steps to Build a Deep Learning Model 1. Defining the model architecture 2. Configure the learning process 3. Train The Model 4. Save the Model 5. Predictions	1	Medium	Sathish Kumar JAGADESH ARVIND LOAKASH

6.PROJECT PLANNING & SCHEDULING

Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Application Building	USN-1	Now that we have trained our model, let us build our flask application which will be running in our local browser with a user interface. In the flask application, the input parameters are taken from the HTML page. These factors are then given to the model to predict the type of food and to know the nutrition content in it. In order to know the nutrition content we will be using an API in this project.	2	High	Sathish Kumar JAGADESH ARVIND LOAKASH
Sprint-2	Train the model on IBM and Image Preprocessing	USN-1	In this milestone, we will register in the IBM cloud and Train the Model in the cloud. Finally we will build a deep learning model. The ImageDataGenerator accepts the original data, randomly transforms it, and returns only the new, transformed data.	2		Sathish Kumar JAGADESH ARVIND LOAKASH
Sprint-3	Data selection	USN-1	we will be improving the image data that suppresses unwilling distortions or enhances some image features important for further processing, although performing some geometric transformations of images like rotation, scaling, translation, etc.	2	High	Sathish Kumar JAGADESH ARVIND LOAKASH
Sprint-4	Model Building	USN-1	Steps to Build a Deep Learning Model 1. Defining the model architecture 2. Configure the learning process 3. Train The Model 4. Save the Model 5. Predictions	1	Medium	Sathish Kumar JAGADESH ARVIND LOAKASH

Sprint Delivery Schedule

Milestone	Activity
Data Collection	Collecting images of food items apples,bananas, oranges, pineapples, watermelons for analysis.
Image Preprocessing	Increasing the amount of data by generating new data points from existing data. Applying image data generator functionality to train and test dataset.
Modeling Phase	Building the model using a deep learning approach and adding CNN layers. Training,saving,testing and predicting the model. Database creation for the input classes.
Development phase	Dashboard creation. Analysis and prediction page creation. Creating feedback and rating page.
Application Phase	Building the python code and importing the flask module into the project. Create the Flask application and load the model. Connecting front end and back end and performing routing and running the application.
Testing Phase	Checking usability and accessibility. Checking scalability and performance of the application.

Reports from JIRA



7.CODING & SOLUTIONING (Explain the features added in the project along with code)

Feature 1

Data Collection

Download the dataset [here](#)

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

Mounted at /content/drive

```
[ ] cd/content/drive/MyDrive/Colab Notebooks
```

/content/drive/MyDrive/Colab Notebooks

```
[ ] # Unzipping the dataset
    !unzip 'Dataset.zip'
```

Image Preprocessing

```
[ ] from keras.preprocessing.image import ImageDataGenerator
```

Image Data Augmentation

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

Applying Image DataGenerator Functionality To Trainset And Testset

```
▶ 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')
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='sparse')
```

Model Building

1. Importing The Model Building Libraries

```
[ ] import numpy as np
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras import layers
from tensorflow.keras.layers import Dense, Flatten
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Dropout
```

2. Initializing The Model

```
[ ] classifier = Sequential()
```

Feature 2

3. Adding CNN Layers

```
[ ] classifier = Sequential()  
classifier.add(Conv2D(32, (3, 3), input_shape=(64, 64, 3), activation='relu'))  
classifier.add(MaxPooling2D(pool_size=(2, 2)))  
classifier.add(Conv2D(32, (3, 3), activation='relu'))  
classifier.add(MaxPooling2D(pool_size=(2, 2)))  
classifier.add(Flatten())
```

4. Adding Dense Layers

```
[ ] classifier.add(Dense(units=128, activation='relu'))  
classifier.add(Dense(units=5, activation='softmax'))
```



```
classifier.summary()
```

Model: "sequential_1"

Layer (type)	Output Shape	Param #
=====		
conv2d (Conv2D)	(None, 62, 62, 32)	896

5. Configure The Learning Process

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

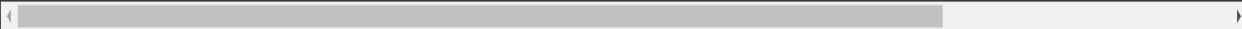
6. Train The Model

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

/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:2: UserWarning: `Model.fit_generator` is deprecated and will be removed in a future version. P]

Epoch 1/20

494/824 [=====>.....] - ETA: 6:52 - loss: 0.7194 - accuracy: 0.7174



7. Saving The Model

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

8. Testing The Model

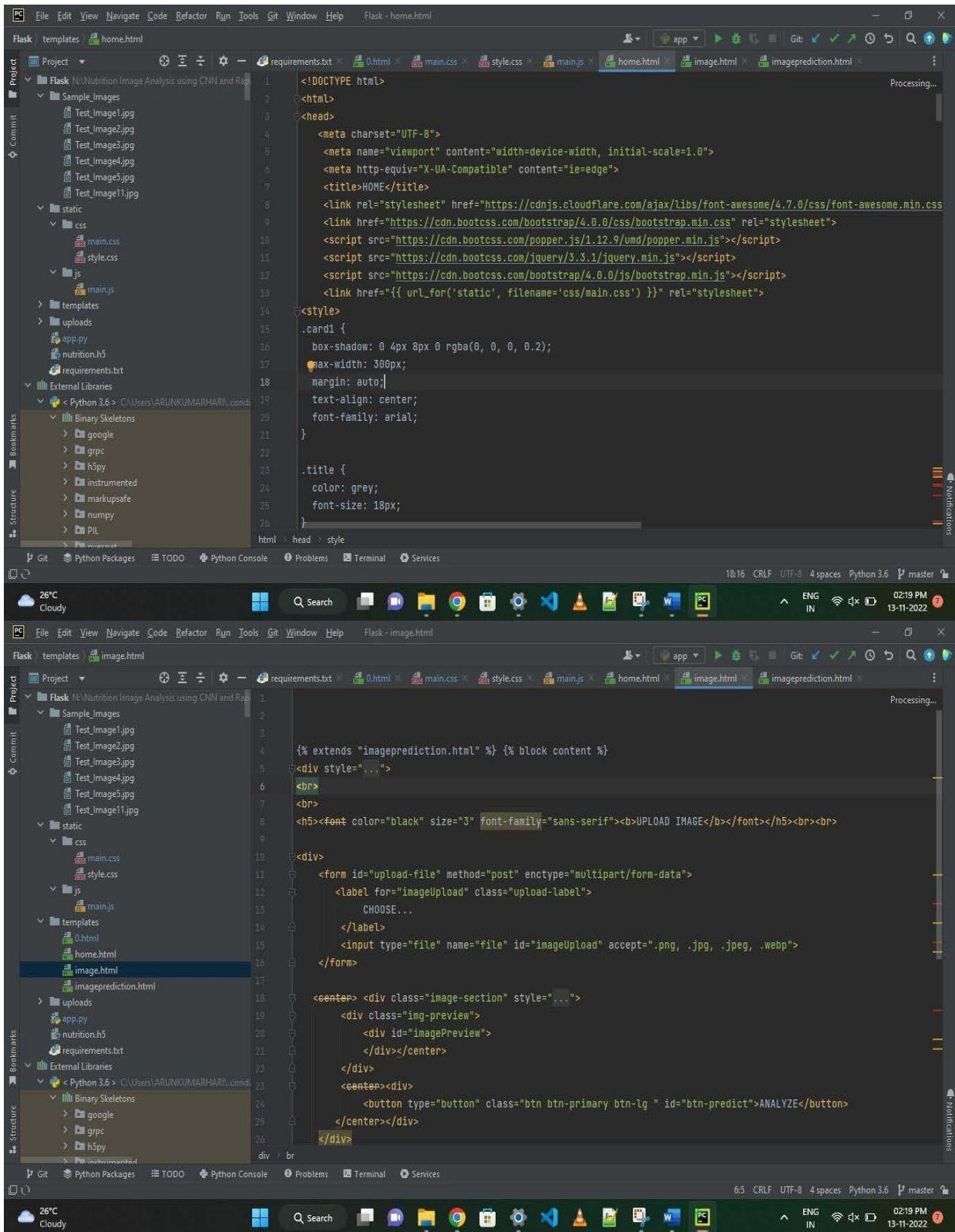
```
[ ] from tensorflow.keras.models import load_model
from keras.preprocessing import image
model = load_model("nutrition.h5")
```

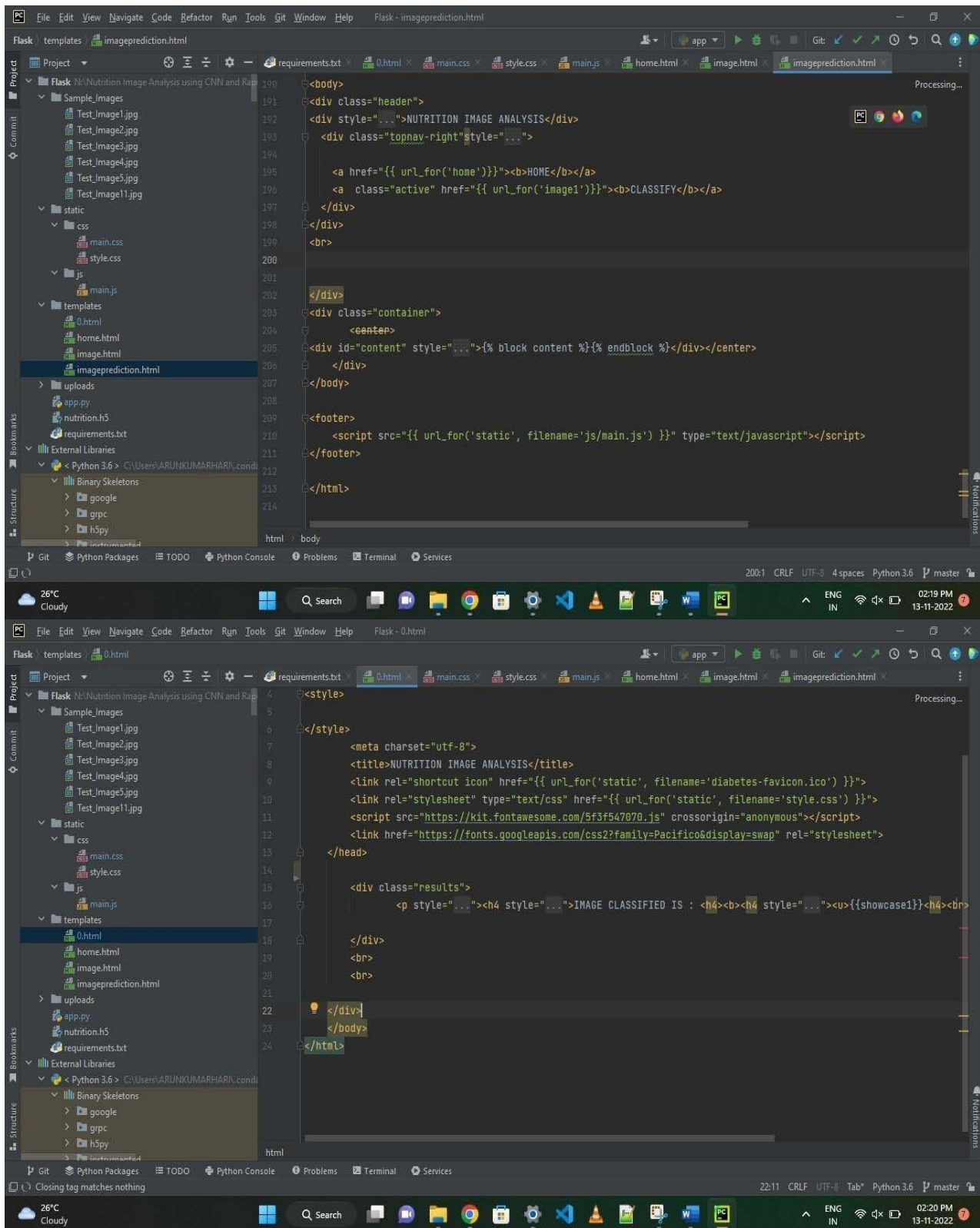
```
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
model = load_model("nutrition.h5")
img = image.load_img(r'/content/drive/MyDrive/Colab Notebooks/Sample Images/Test_Image1.jpg', grayscale=False, target_size= (64,64))
x = img_to_array(img)
x = np.expand_dims(x, axis = 0)
predict_x=model.predict(x)
classes_x=np.argmax(predict_x,axis=-1)
classes_x
```

1/1 [=====] - 0s 62ms/step
array([0])

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

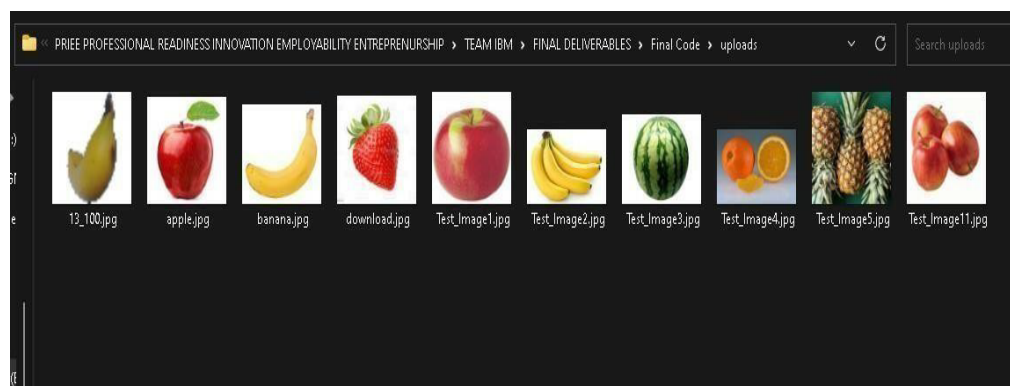
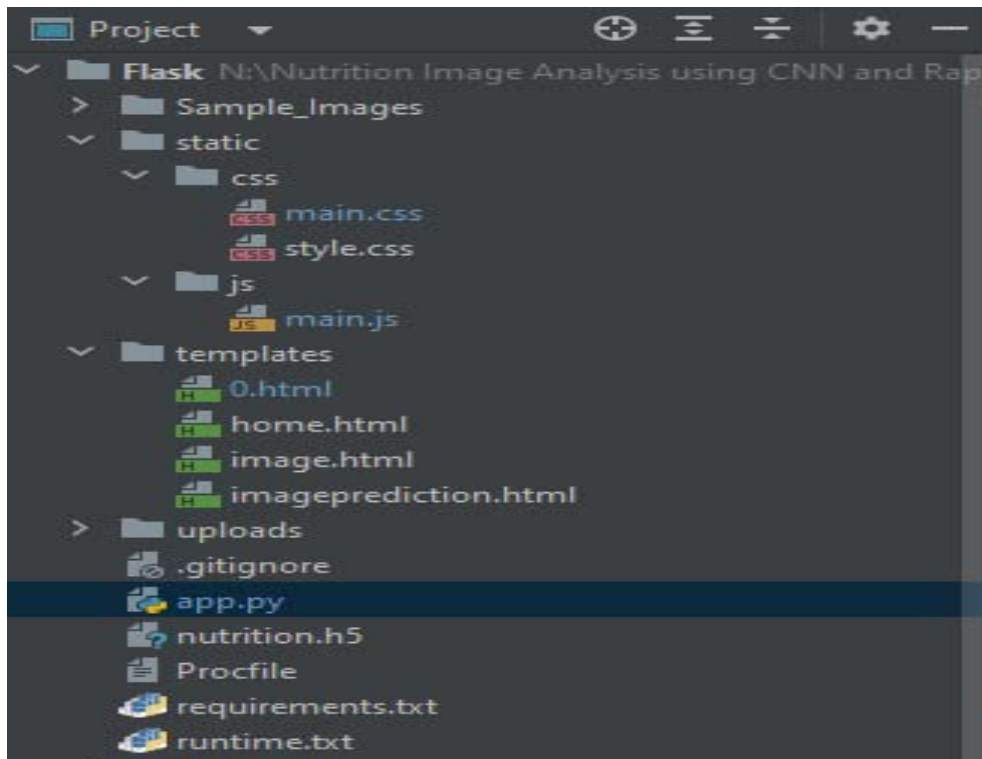
Feature 3





8 . TESTING

Test Cases

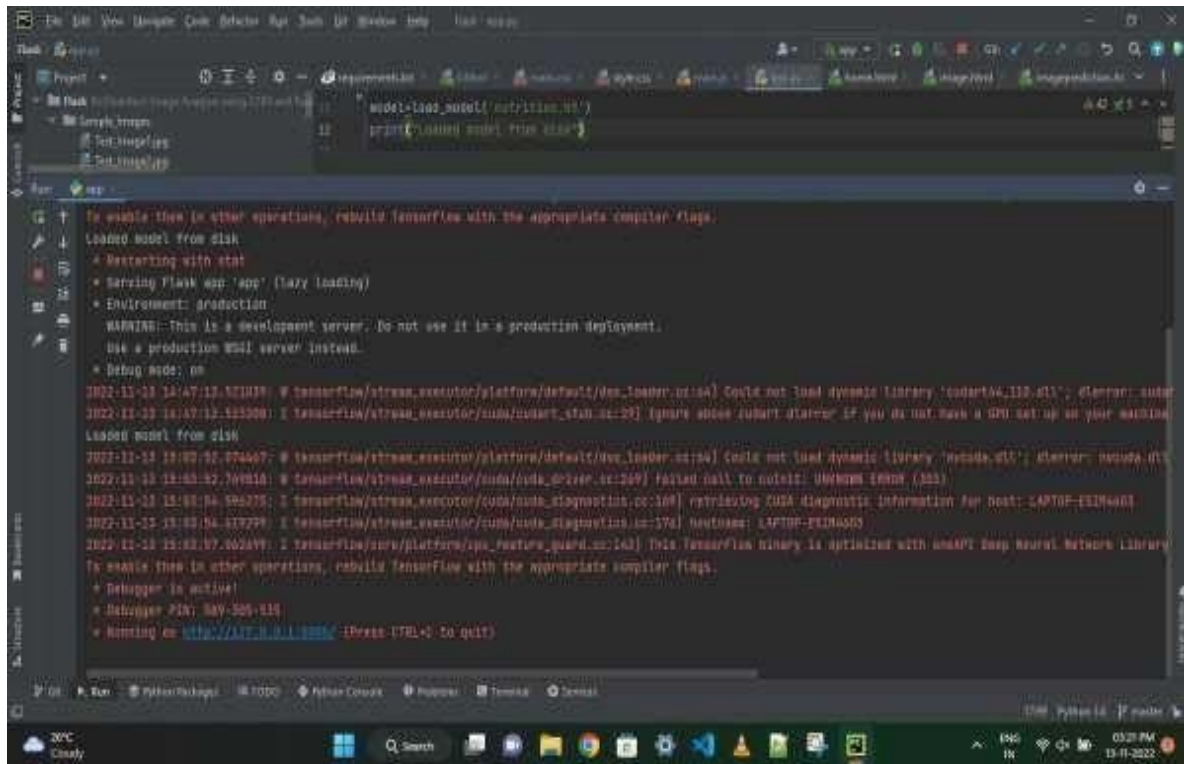


User Acceptance Testing



9 . RESULTS

9.1 Performance Metrics



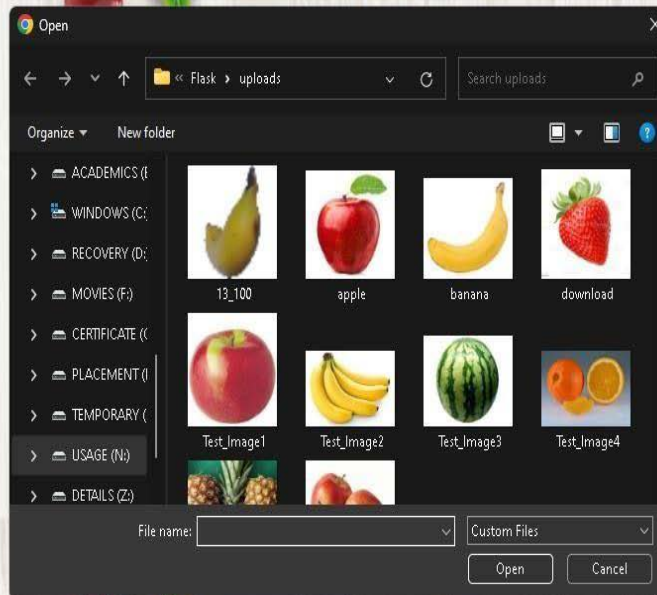
Output



UPLOAD IMAGE

CHOOSE...

ANALYZE



UPLOAD IMAGE

CHOOSE...



IMAGE CLASSIFIED IS :

APPLES

[{'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}]

10 . ADVANTAGES & DISADVANTAGES

ADVANTAGES

- New dietary assessment and nutrition analysis tools provide more opportunities to help people understand their daily eating habits
- It helps in exploring nutritional patterns in their daily routines and this is very helpful for people to maintain a balanced healthy diet.
- Nutritional analysis is used to determine the nutritional content of foods.
- This app eliminates travel costs when visiting a nutritionist.
- Using this app greatly reduces the time required to get the best diet plan

DISADVANTAGES

- Android mobile user will not be able to insert or view details if the server is down.
- So the disadvantage is single point failure.

11. CONCLUSION

We will be by the end of this project

- know the basic concepts and techniques of a convolutional neural network.
- gain a broad understanding of image data
- know how to create a web application using the Flask framework.
- know how to preprocess data and
- know how to clean data using various data pre-processing techniques.

12. FUTURE SCOPE

- Artificial intelligence is revolutionizing healthcare.
- Mainly used to improve marketing and sales decisions, AI is now also being used to reshape individual habits.
- We don't want to go to the gym and follow any diets in the future. With this nutrition analyzer we can maintain our diet plans without the help of others and can lead a happy and healthy life with good wealth.
- AI can easily track health behaviors and repetitive exercise patterns and use the data to guide you on your fitness journey and diet plans.

13. APPENDIX

Source Code

```
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)
```

GitHub - <https://github.com/IBM-EPBL/IBM-Project-21761-1659790743>

Demo link -

https://drive.google.com/drive/folders/1SSaCWhgeQ2ZZtmznaxrZLdpdo-U_45WJ?usp=share_link