TEAM ID : PNT2022TMID01549

PROJECT NAME : AI-Powered Nutrition Analyzer For Fitness Enthusiasts

Project Report Format

1. INTRODUCTION

1.1 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.).

2. LITERATURE SURVEY

2.1 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.

2.2 References

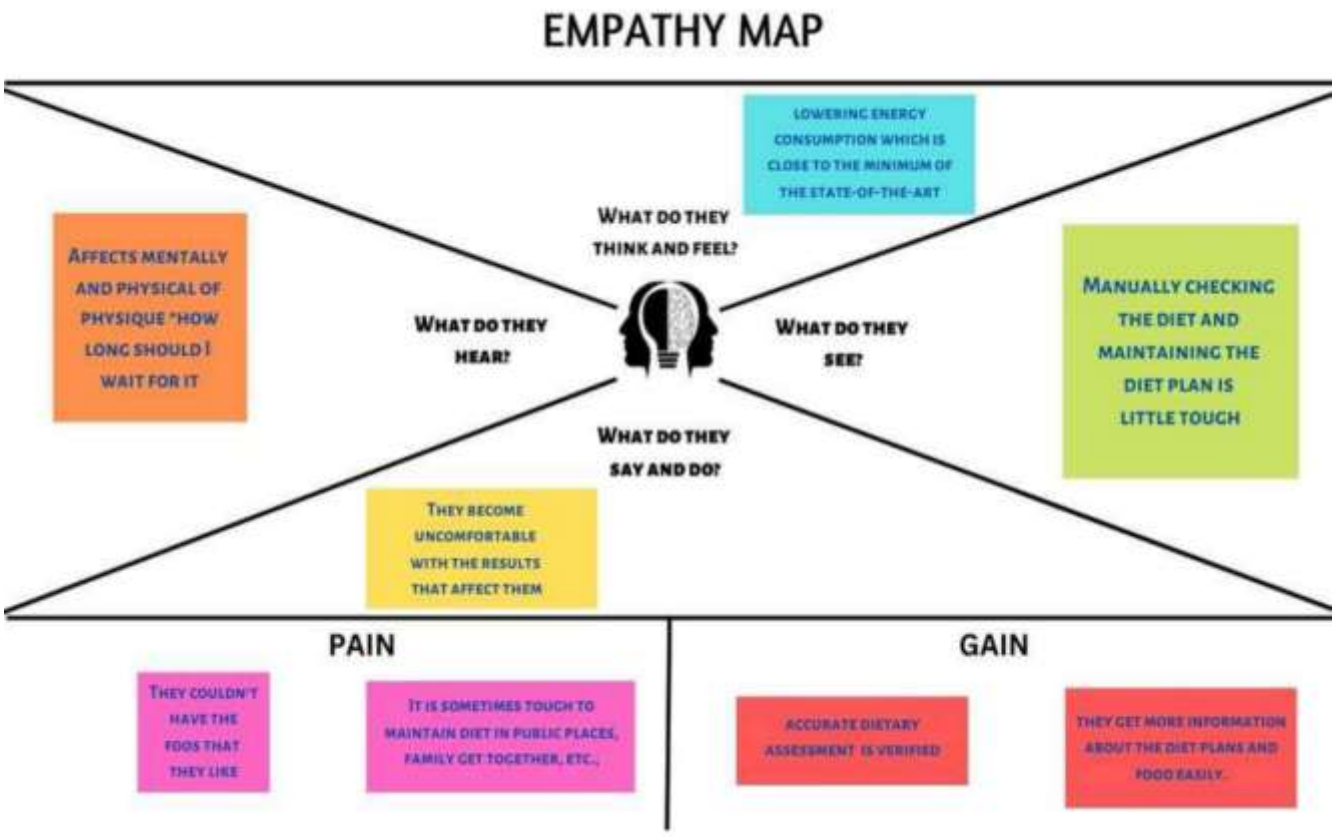
https://www.nutrinohealth.com/

2.3 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

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming

MIRUDHULAA S

CLARITY ON DIET MYTHS AND NUTRITIONAL FAKE NEWS .	ONLINE NUTRITION COUNSELING.	GROUP FITNESS COMMUNITY.	HEALTHY MEAL KIT DELIVERY SERVICE.
WEEKLY DETOX.	POWER LIFTING TRAINING.	CUSTOMIZED PERFECT WORKOUT PLANS/CHARTS.	CALISTHENICS TRAINING.

PRASETHA N

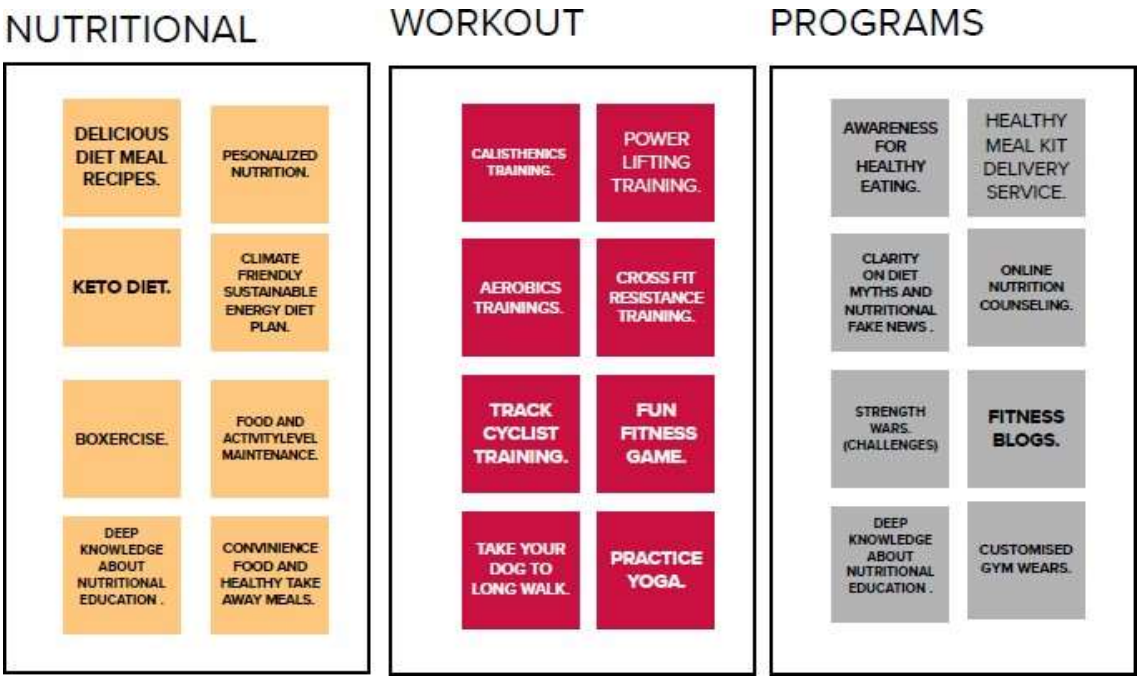
TAKE YOUR DOG TO LONG WALK.	CUSTOMISED GYM WEARS.	AWARENESS FOR HEALTHY EATING.	DELICIOUS DIET MEAL RECIPES.
KETO DIET.	PESONALIZED NUTRITION.	PRACTICE YOGA.	TRACK CYCLIST TRAINING.

MONISHA S

VEGAN-PLANT BASED NUTRITION.	CUPPING AND ACCUPRESSURE THERAPY.	FITNESS BLOGS.	CROSS FIT RESISTANCE TRAINING.
PALEO DIET.	JOIN TEAM SPORT.	PROHIBITS : NOURISHMENT FOR THE GUT HEALTH.	AEROBICS TRAININGS.

KAVYA SREE S

CLIMATE FRIENDLY SUSTAINABLE ENERGY DIET PLAN.	STRENGTH WARS. (CHALLENGES)	CONVINIENCE FOOD AND HEALTHY TAKE AWAY MEALS.	FOOD AND ACTIVITYLEVEL MAINTENANCE.
DEEP KNOWLEDGE ABOUT NUTRITIONAL EDUCATION .	TAKE ENOUGH AMOUNT OF SLEEP.	BOXERCISE.	FUN FITNESS GAME.



3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	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.	Idea / Solution description	The idea of this application is that 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. This idea is achieved by using the Convolution Neural Network (CNN) .
3.	Novelty / Uniqueness	The application has the feature of analysing the entire nutritional content of fruits and vegetables by simply scanning them.
4.	Social Impact / Customer Satisfaction	It is used to schedule a diet plan by taking the image of a food item. We can get information about the nutrition present in the item like carbohydrates, fat, proteins, vitamins, minerals and sugar. This will help others to improve their health and fitness.
5.	Business Model (Revenue Model)	Social media is the best way to spread the world about our application and with the help of influencers we can attract normal people. Clustering and targeting the fitness people with the help of local gyms. Allowing third-party vendors (Nutritional Products) to sell their products through our app via advertisements is way to generate money. If the products sold through advertisements, then it is even better.

6.	Scalability of the Solution	Scalable AI pertains to how data models, infrastructures, and algorithms can increase or decrease their complexity, speed, or size at scale in order to best handle the requirements of the situation at hand. As improvements continue with data storage capacities as well as computing resources, AI models can be created with billions of parameters. Scaling up nutrition is a global push for action and investment to improve maternal, child nutrition and various health problems

3.4 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

4.1 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.

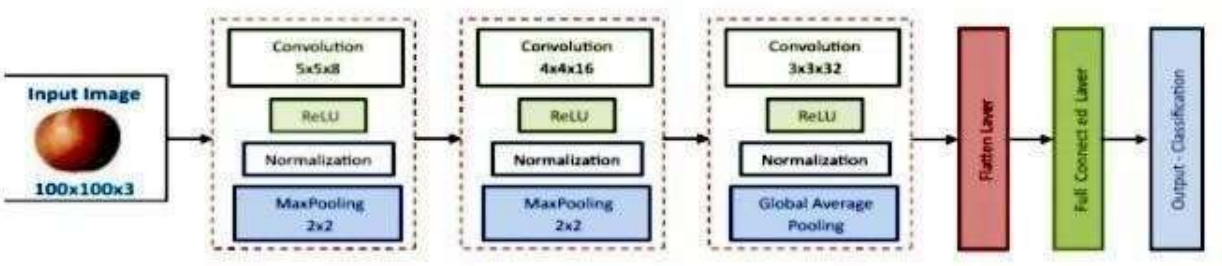
• Here the user can capture images of different fruits and then the image will be sent to the trained model. The model analyzes the image and detects nutrition based on the fruit as (sugar, fiber, protein, calories, etc.)

• 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.: dietary requirement = metabolic need/utilization efficiency.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Users can create an account to use the application. This can be done by creating a persona in the app with a username and password or using existing email id.
FR-2	User Confirmation	As soon as the user registers in the application, he will receive a confirmation to his e-mail, which he provided for registration. Integrated OTP authentication ensures no identity theft occur.
FR-3	Calorie Calendar Creation	When a user profile is created, a calendar associated with the account is generated. This calendar is private to the user and tracks calories consumed in a day and related statistics.

FR-4	Calorie Value Computation	Once the ingredient labels and amounts are located, the net caloric value of the food is calculated by adding the calories of each ingredient in their respective amounts. Calorie values are obtained from the Internet, while calorie values of frequently used items are retrieved from the database.
FR-5	Storage of Data	User data and login data are stored in backend database. In addition, caloric information about frequently consumed ingredients is also stored to minimize overhead and complexity.
FR-6	Calorie Over-Consumption Notification	When the user exceeds the allowed consumption of calories for a given day, the application issues a notification. The application then suggests low-calorie diets that ensure minimal overconsumption.

FR-7	Diet Plan Specification	Users can select the kind of diet plan they want to follow with a target in mind such as weight loss, muscle building, etc. The applicationsources diet plans and food items that supplement their goals from the internet to help them achieve their goal.

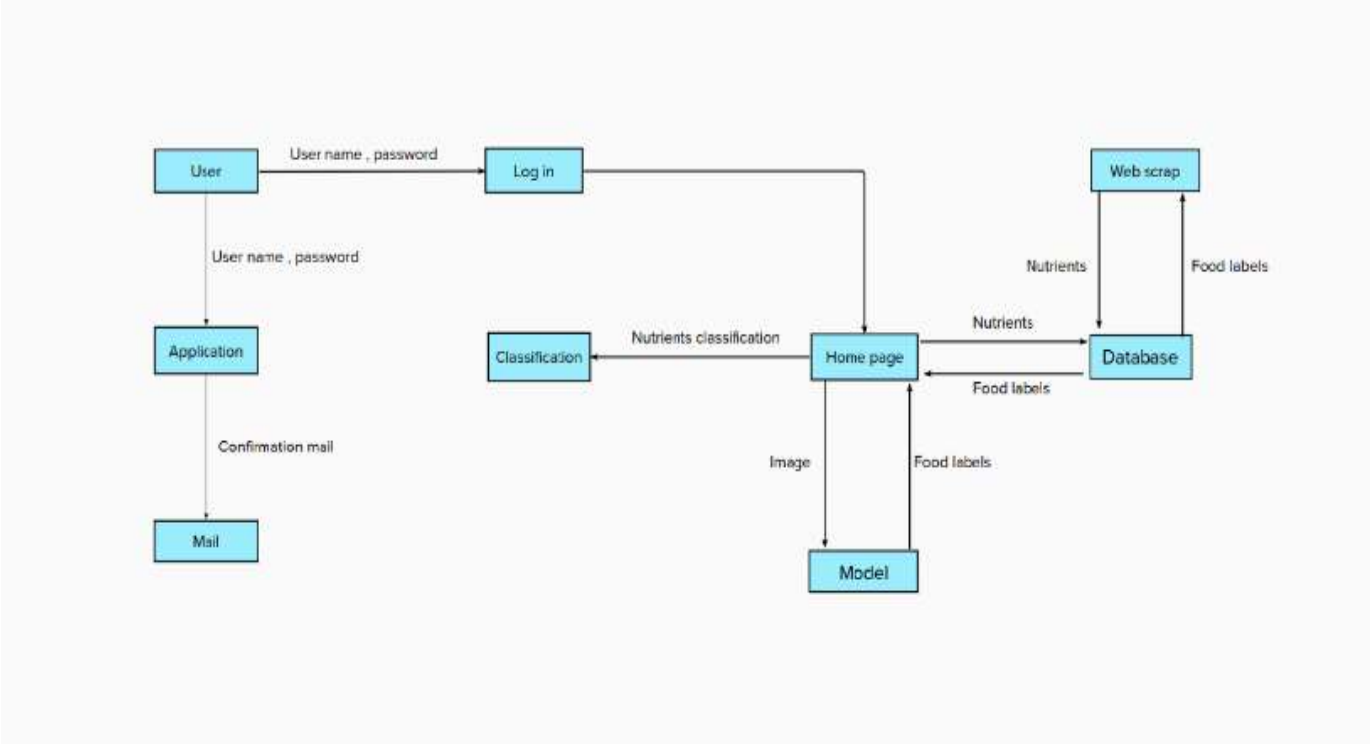
4.1 Non-Functional requirements

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Users should be able to use the app without any problems. The interface should be easy to use and understand. The image capture process should be smooth and not lengthy.
NFR-2	**Security**	Details about users and their personal calorie calendar should not be disclosed or shared with others users. Privacy should be secured.

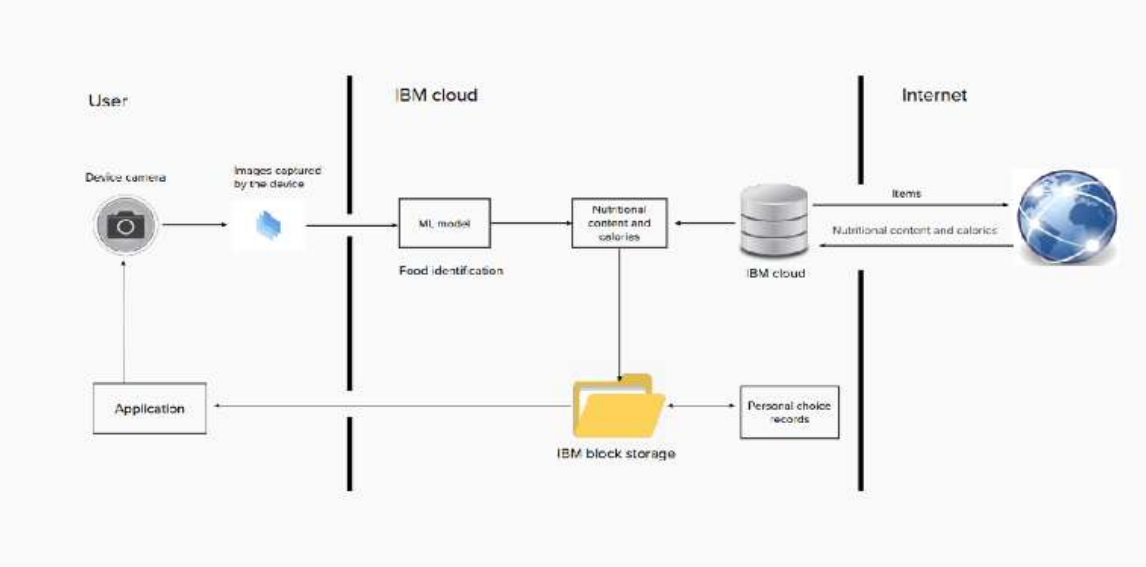
NFR-3	**Reliability**	The application should correctly identify the fruit from the captured image and obtain its nutritional value. The count and calculation calories should be done accurately.
NFR-4	**Performance**	The application should be built on a highly efficient prediction model so that the results are accurate. It should remember time and space complexity.
NFR-5	**Availability**	The application should be constantly available to its users and should work efficiently. It should not suffer from problems such as the application will crash.
NFR-6	**Scalability**	The app should be able to support updates in terms of features and functionality. The system should be built to upgrade using the existing foundation architecture.

5. PROJECT DESIGN

5.1 Data Flow Diagrams



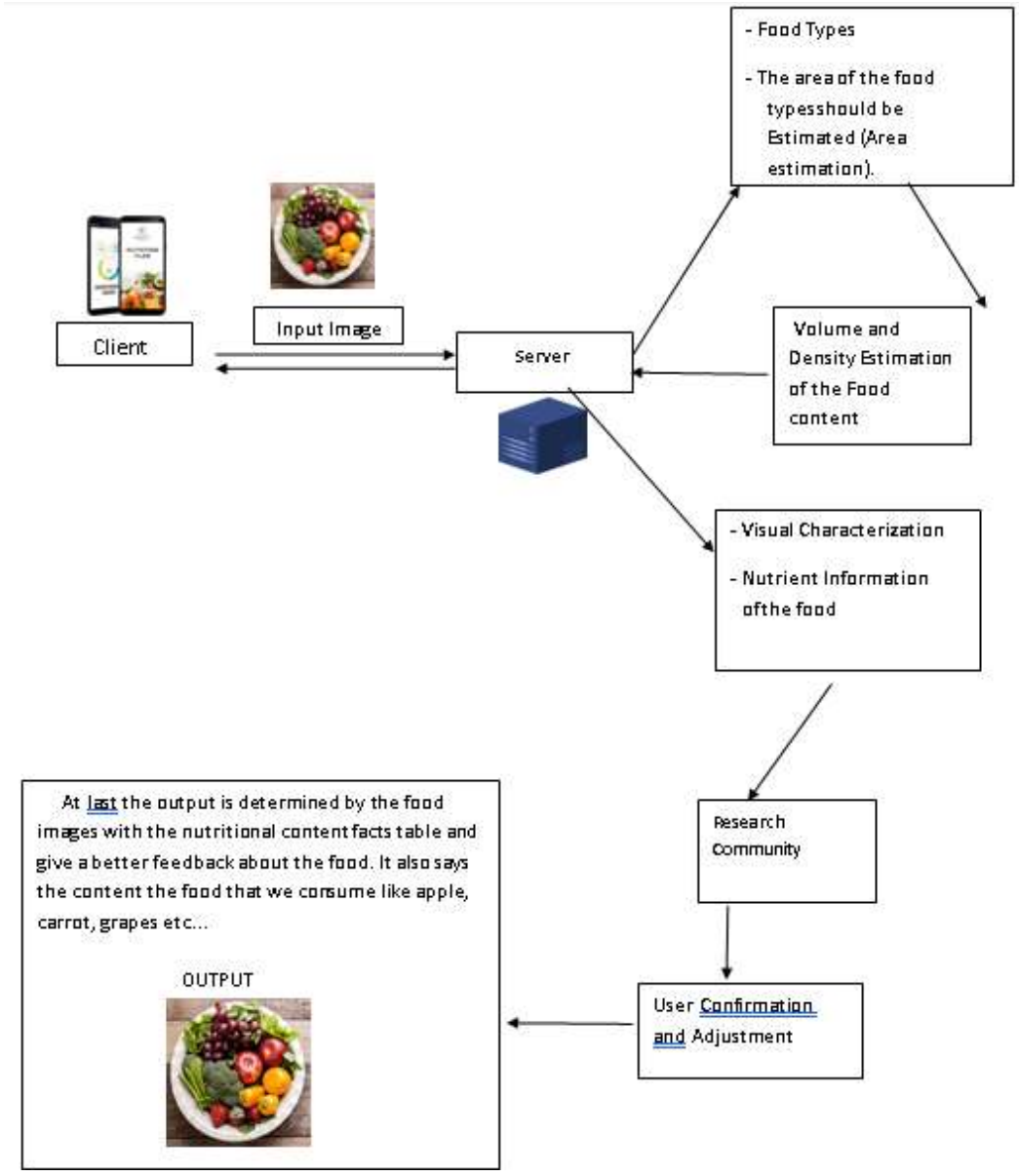
5.2 Solution & Technical Architecture



S.No	Component	Description	Technology
1.	App	User interacts with application for the prediction of Nutrition	Python, Java, HTML, SQLite, Android studio
2.	Database	Data Type, Configurations and data will be stored	MySQL, JS
3.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
4.	File Storage	File storage requirements	Cloud -- > drive
5.	Machine Learning Model	Purpose of Machine Learning Model	ANN, CNN, RNN
6.	Notification	Notification will be sent from the server	SendGrid

Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Open-source frameworks used	SendGrid, Python, JQuery
2.	Security Implementations	Request authentication using encryption	Encryptions, SSL certs
3.	Scalable Architecture	The scalability of architecture consists of 3 tiers	Web Server – HTML, CSS ,Javascript Application Server –Python Flask Database Server – IBM Cloud
4.	Availability	Availability is increased by loads balancers in cloud VPS	IBM Cloud hosting
5.	Performance	The application is expected to handle up to 4000 predications per second	IBM Load Balance


- Food Types
- The area of the food typesshould be Estimated (Area estimation).
Client
Input Image
Server
Volume and Density Estimation of the Food content
- Visual Characterization
- Nutrient Information ofthe food
Research Community
User Confirmation and Adjustment
At last the output is determined by the food images with the nutritional content facts table and give a better feedback about the food. It also says the content the food that we consume like apple, carrot, grapes etc...
OUTPUT

5.3 User Stories

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection	USN-1	Dataset - Collecting images of food items apples, banana, orange, pineapple, watermelon for analysis	5	High	PRASETHA N
Sprint-1	Image Preprocessing	USN-2	Image data augmentation Increasing the amount of data by generating new data points from existing data	4	Medium	MONISHA S
Sprint-1		USN-3	Image Data Generator Class - Used for getting the input of the original data	4	Medium	MIRUDHULAA S
Sprint-1		USN-4	Applying image data generator functionality to train set and test set	4	Medium	KAVYA SREE
Sprint-2	Modeling Phase	USN-5	Defining the model architecture - Building the model using deep learning approach and adding CNN layers	4	High	PRASETHA N
		USN -6	Training, saving, testing and predicting the model	5	High	MIRUDHULAA S
Sprint-2		USN- 7	Database creation for the input classes	4	High	KAVYA SREE

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection	USN-1	Dataset - Collecting images of food items apples, banana, orange, pineapple, watermelon for analysis	5	High	PRASETHA N
Sprint-1	Image Preprocessing	USN-2	Image data augmentation Increasing the amount of data by generating new data points from existing data	4	Medium	MONISHA S
Sprint-1		USN-3	Image Data Generator Class - Used for getting the input of the original data	4	Medium	MIRUDHULAA S
Sprint-1		USN-4	Applying image data generator functionality to train set and test set	4	Medium	KAVYA SREE
Sprint-2	Modeling Phase	USN-5	Defining the model architecture - Building the model using deep learning approach and adding CNN layers	4	High	PRASETHA N
		USN -6	Training, saving, testing and predicting the model	5	High	MIRUDHULAA S
Sprint-2		USN- 7	Database creation for the input classes	4	High	KAVYA SREE

6.2 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.

6.3 Reports from JIRA

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

```
[1] import numpy as np
    import tensorflow
    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
    from keras.preprocessing.image import ImageDataGenerator
```

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

```
x_train = train_datagen.flow_from_directory(
    r'/content/drive/MyDrive/IBM/Dataset-PNT2022TMID01549/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/IBM/Dataset-PNT2022TMID01549/Dataset/TEST_SET',
    target_size=(64, 64),batch_size=5,color_mode='rgb',class_mode='sparse')
```

```
Found 2656 images belonging to 5 classes.
Found 1055 images belonging to 5 classes.
```

F

Initializing the Model

```
[7] model = Sequential()
```

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())
```

Adding Dense Layers

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

```
[10] classifier.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
 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
_________________________________________________________________
```

Configure The Learning Process

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

Train The Model

```
[13] classifier.fit_generator(
         generator= train,steps_per_epoch = len(x_train),
         epochs=10, validation_data=x_test,validation_steps = len(x_test))
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: UserWarning: `Model.fit_generator` is deprecated and will be removed in a future version. Please use `Model.fit`,
  """Entry point for launching an IPython kernel.
Epoch 1/10
532/532 [==============================] - 688s 1s/step - loss: 0.1738 - accuracy: 0.9469 - val_loss: 0.1084 - val_accuracy: 0.9769
Epoch 2/10
532/532 [==============================]  - 284s 534ms/step - loss: 0.0466 - accuracy: 0.9872 - val_loss: 0.0744 - val_accuracy: 0.9739
Epoch 3/10
532/532 [==============================] - 283s 532ms/step - loss: 1.8299e-04 - accuracy: 1.0000 - val_loss: 0.0509 - val_accuracy: 0.9774
Epoch 4/10
532/532 [==============================] - 284s 534ms/step - loss: 0.0113 - accuracy: 0.9960 - val_loss: 0.1068 - val_accuracy: 0.9725
Epoch 5/10
532/532 [==============================]  - 285s 536ms/step - loss: 1.1175e-04 - accuracy: 1.0000 - val_loss: 0.0399 - val_accuracy: 0.9858
Epoch 6/10
532/532 [==============================] - 285s 536ms/step - loss: 5.3437e-05 - accuracy: 1.0000 - val_loss: 0.0389 - val_accuracy: 0.9881
Epoch 7/10
532/532 [==============================] - 284s 534ms/step - loss: 0.0191 - accuracy: 0.9986 - val_loss: 0.0223 - val_accuracy: 0.9867
Epoch 8/10
532/532 [==============================] - 284s 534ms/step - loss: 1.1c06e-04 - accuracy: 1.0000 - val_loss: 0.0716 - val_accuracy: 0.9744
Epoch 9/10
532/532 [==============================] - 283s 532ms/step - loss: 2.8955e-05 - accuracy: 1.0000 - val_loss: 0.0474 - val_accuracy: 0.9782
Epoch 10/10
532/532 [==============================] - 274s 514ms/step - loss: 1.1144e-05 - accuracy: 1.0000 - val_loss: 0.0445 - val_accuracy: 0.9781
<keras.callbacks.History at 0x7fcb1f2b51d0>
```

Save the Model

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

Test the Model

```
[14] 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-PNT2022TMID01549/Dataset/TEST_SET/ORANGE/30_100.jpg",target_size= (64,64))
img
```

```
[16] x=image.img_to_array(img)
```

```
[17] x
```

```
array([[[255., 255., 242.],
        [255., 255., 251.],
        [255., 255., 255.],
        ...,
        [255., 255., 255.],
        [255., 255., 255.],
        [255., 255., 255.]],

       [[255., 255., 251.],
        [254., 253., 251.],
        [255., 253., 254.],
        ...,
        [255., 255., 255.],
        [255., 255., 255.],
        [255., 255., 255.]],
```

```
[18] x.ndim
```

```
3
```

```
[19]
x=np.expand_dims(x,axis=0)
```

```
[20] x.ndim
```

```
4
```

```
[21]
pred = classifier.predict(x)
```

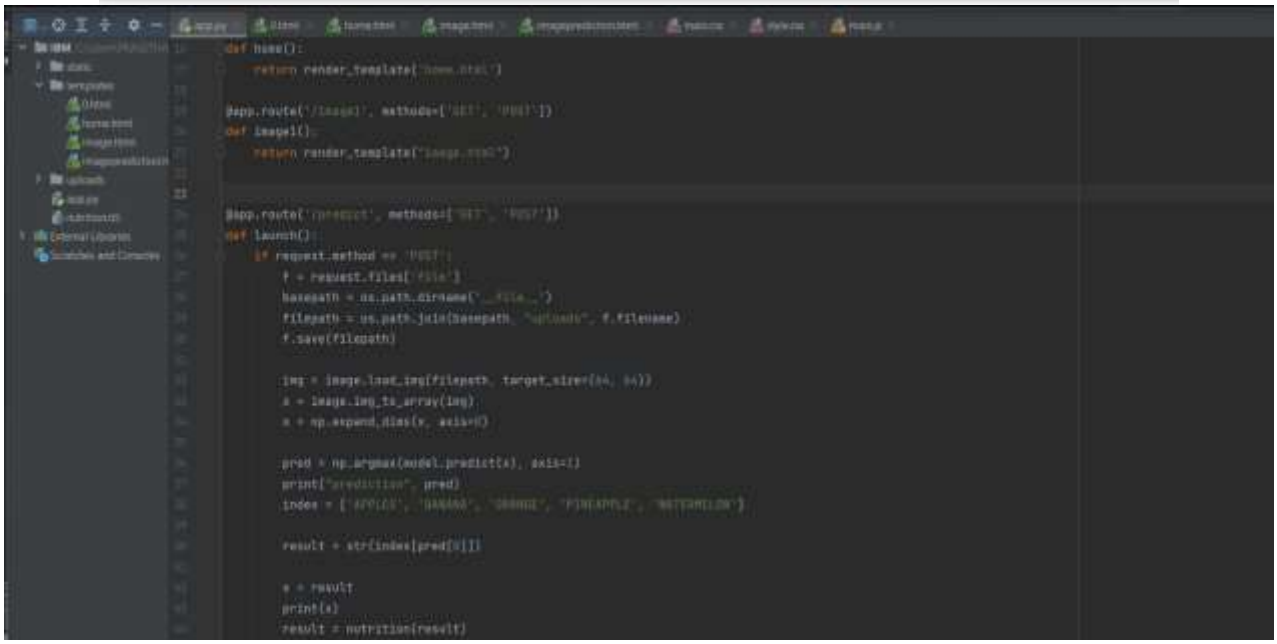
```
1/1 [==============================] - 0s 112ms/step
```

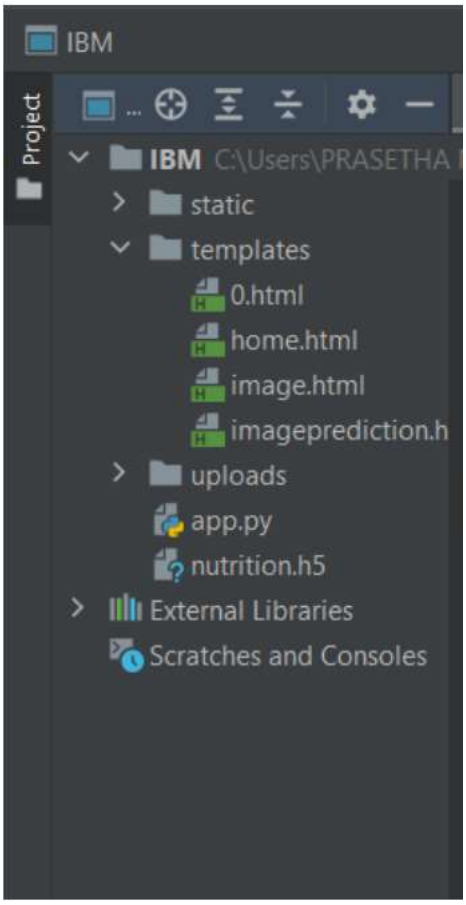
```
[22] pred
```

```
array([[0., 0., 1., 0., 0.]], dtype=float32)
```

```
labels=['APPLES', 'BANANA', 'ORANGE','PINEAPPLE','WATERMELON']
labels[np.argmax(pred)]
```

```
'ORANGE'
```

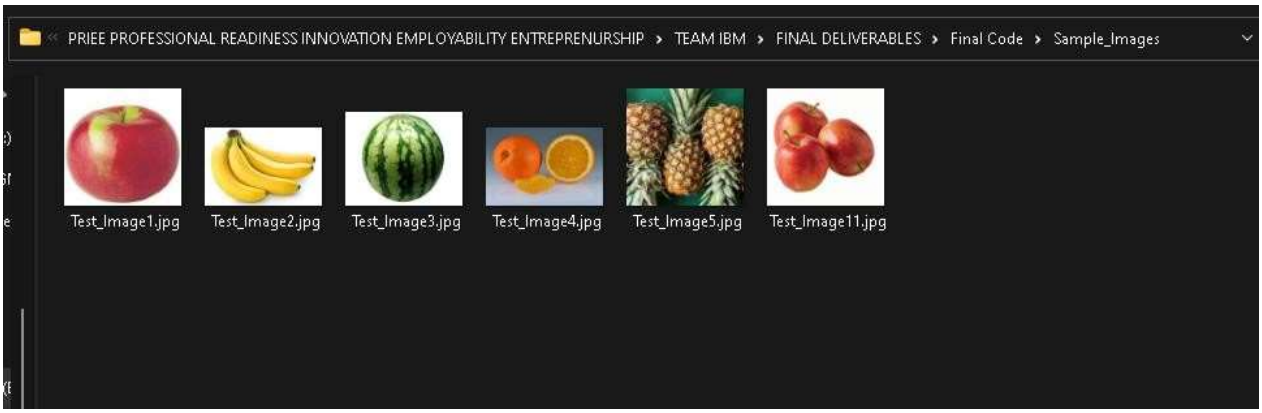



IBM
Project
IBM C:\Users\PRASETHA
static
templates
0.html
home.html
image.html
imageprediction.h
uploads
app.py
nutrition.h5
External Libraries
Scratches and Consoles

8. TESTING

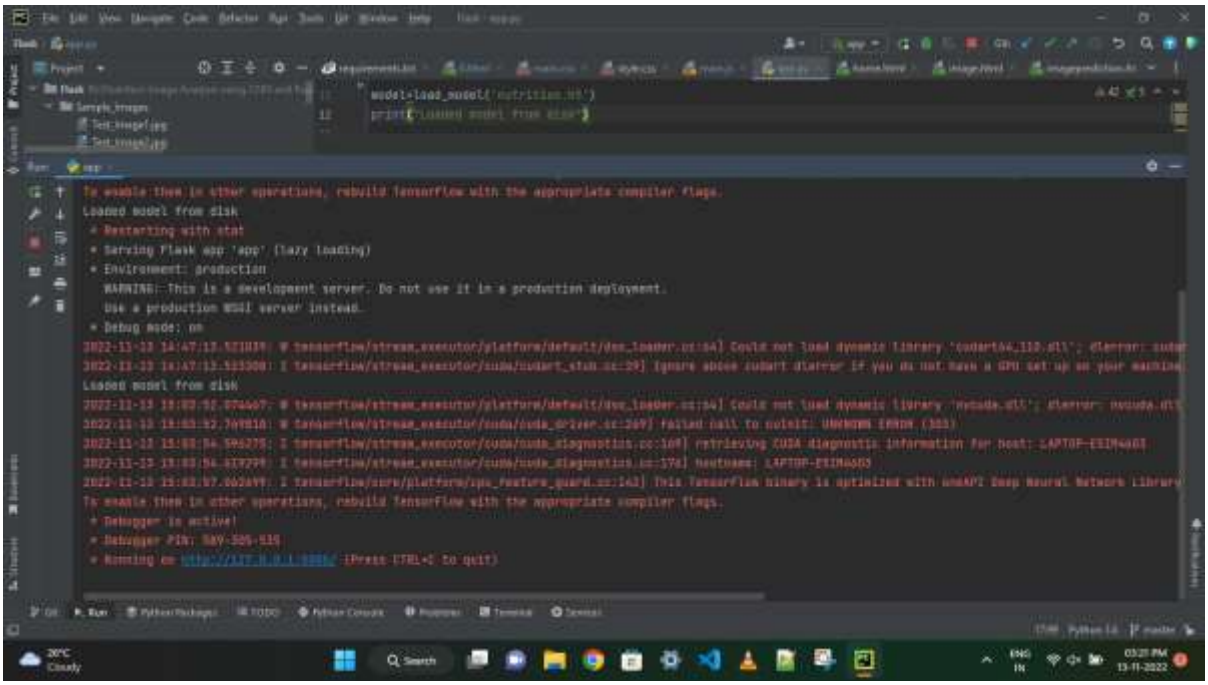
8.1 Test Cases

1.1 User Acceptance Testing

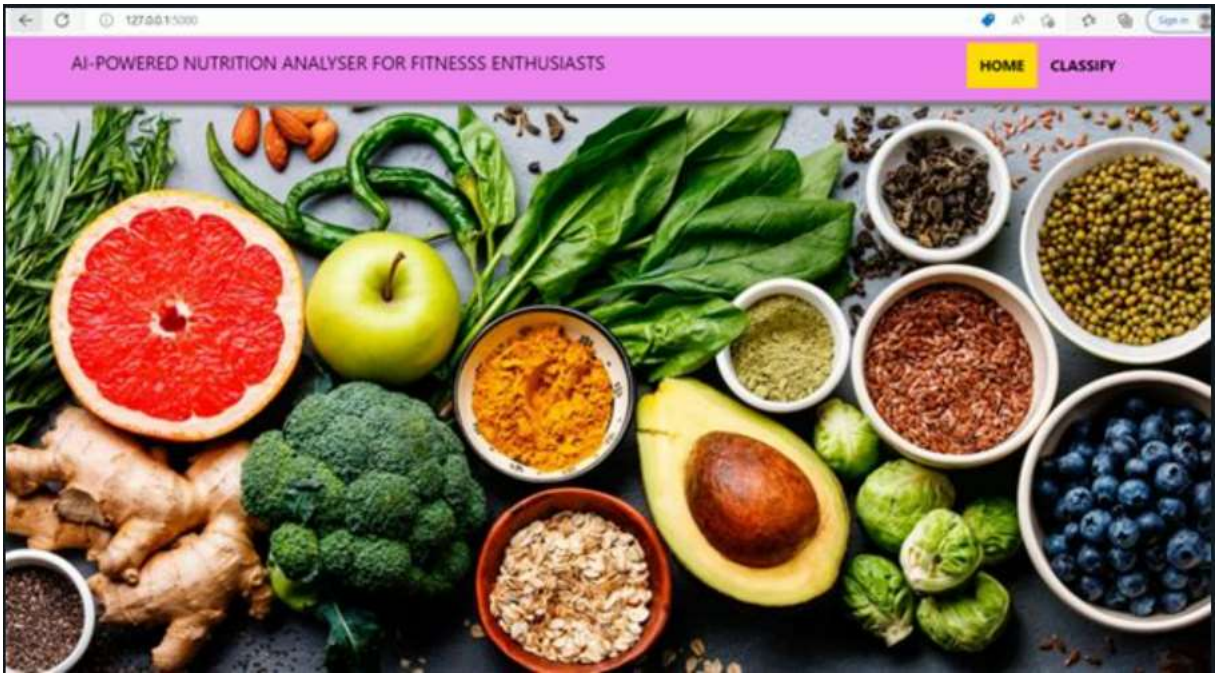


2. RESULTS

2.1 Performance Metrics



2.2 Output


AI-POWERED NUTRITION ANALYSER FOR FITNESSS ENTHUSIASTS
HOME
CLASSIFY


AI-POWERED NUTRITION ANALYSER FOR FITNESSS ENTHUSIASTS
HOME
CLASSIFY
FOOD IS ESSENTIAL
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.

AI IN FOOD INDUSTRY

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.).

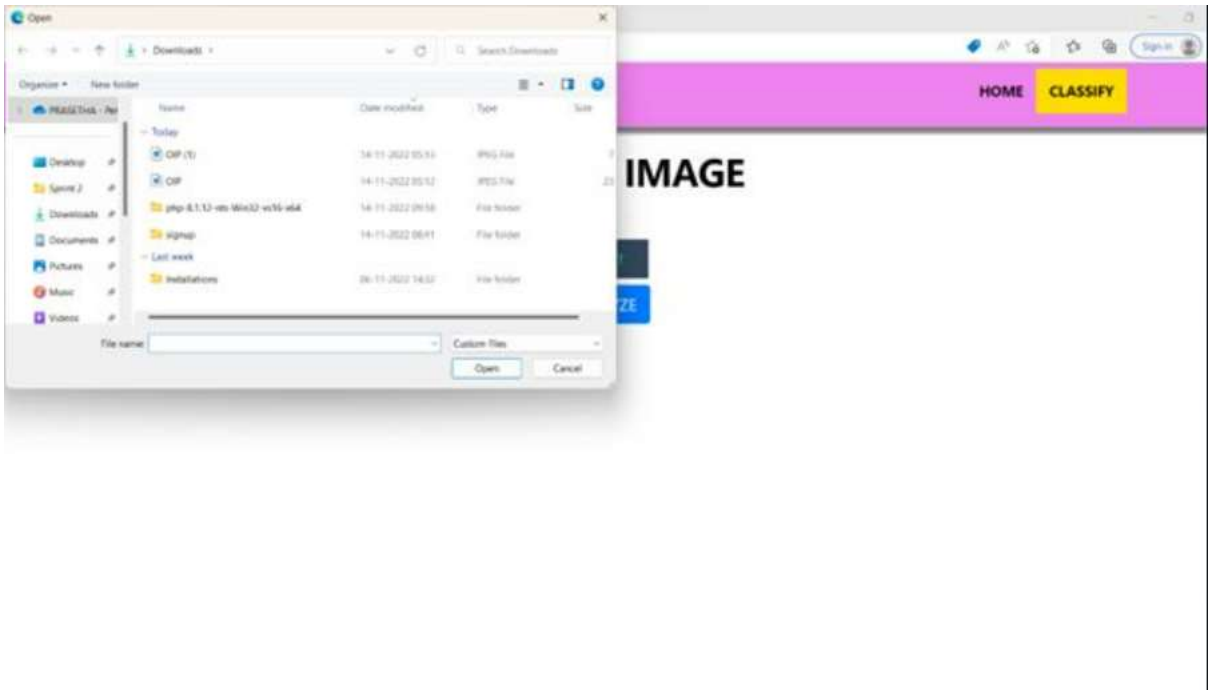
AI-POWERED NUTRITION ANALYSER FOR FITNESS ENTHUSIASTS

HOME CLASSIFY

UPLOAD IMAGE

SELECT

ANALYZE


Open
Downloads
Organize
New folder
Today
Last week
File name:
Custom Files
Open
Cancel
HOME
CLASSIFY
IMAGE


AI-POWERED NUTRITION ANALYSER FOR FITNESS ENTHUSIASTS
HOME
CLASSIFY
UPLOAD IMAGE
SELECT
ANALYZE

1. 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.

12. 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.

13. 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.

2. APPENDIX

Source Code - https://drive.google.com/drive/folders/1g2ag-EAGjKJi7bgInff9qCiSy-WxlW6_?usp=sharing

GitHub - https://github.com/IBM-EPBL/IBM-Project-37359-1660305642

Demo link - https://drive.google.com/drive/folders/14xfgNjmatTPnkgFH213OhSXo5X8YdfBa?usp=sharing