AI POWERED NUTRITION ANALYZER FOR FITNESS ENTHUSIASTS

Team ID	PNT2022TMID46718
Project Name	AI-Powered Nutrition Analyzer For Fitness Enthusiasts
Team Members	K.Varun K.Vignesh P.Gopinath K.Akash

1. INTRODUCTION

1.1 PROJECT OVERVIEW

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.

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.).

1.2 PURPOSE

Nutrition is a critical part of health and development. Better nutrition is related to improved infant, child and maternal health, stronger immune systems, safer pregnancy and childbirth, lower risk of non-communicable diseases (such as diabetes and cardiovascular disease), and longevity.

2 LITERATURE SURVEY

2.1 EXISTING PROBLEM

Paper / Title	Author	Year	Objective	Proposed Technique	Limitations/ Improvements
EVIDENCE-BASED DEVELOPMENT OF AMOBILE TELEPHONE FOOD RECORD	Bethany L Six, TusaRebecca E Schap, Anand Mariappan,	2011	(1) to test whether participants' proficiency repeated use.	1) Image Segmentation 2) Volume Estimation 3) FNDDS Indexing Nutrient Info	Needs to Accommodate the lifestyles of its users to ensure useful images and continuous use throughout the day or multiple days.
FOOD IMAGE ANALYSIS AND DIETARY ASSESSMENTVIA DEEP MODEL	Landu Jiang	2020	To design and implement a system for food image Analysis - output the amount of nutritional ingredients of each food items from daily captured images. A thorough	Extract the regions of interests (ROIs) by ap-plying regression module isalso used to locate thefood coordinates in the image.	To provide a healthy diet, an automatic dietcalculator.

			dietary assessment report will be generated based on what you have during the meal.		
AUTOMATIC FRUIT RECOGNITION:A SURVEY AND NEW RESULTSUSING RANGE/ATTENU ATIONIMAGES	Jimene z A, Jain A, Ceres R, Pons J.	1999	To recognize spherical fruits in different situations such as shadows, bright areas, occlusion s	Two images represent the azimuth and elevation angles the attenuation image *REFL(x, y)*. The image an alysis process uses the images obtained from the scanner to detect the position of the fruits by thresholding and clustering.	Cannot work with low resolution images.
DEEPFOOD: DE EPLEARNING-	Chang Liu, Yu	2016	To propose a new	A new architecture was proposed based	The inference time is extremely long for even a

BASED FOOD IMAGE RECOGNITION FORCOMPUTER-AIDED DIETARY ASSESSMENT	Cao, Yan Luo, Guanling Chen, Vinod Vokkarane, and Yunsheng Ma		CNN architecture for food image recognition and apply benchmark on UEC-256 and Food-101	on the backbones of LeNet, AlexNet and GoogleNet. After convolutions, it was followed by sub- sampling to reduce dimensions and FC layers.	single image and hence not feasible to deploy in real time
DEEP-LEARNING-ASSISTED MULTI-DISH FOOD RECOGNITION APPLICATION FOR DIETARY INTAKE REPORTING	Ying-Chieh Liu	2022	To integrate ML innovations of real conditions.	Adopted EfficientDet-D1 with EfficientNet-B1 as the backbone. EfficientDet detector architecture with EfficientNet was selected	Yet to be integrated with a mobile app or web application.

2.2 REFERENCES

1. Usda food and nutrient database for dietary studies, 1.0. Beltsville, MD: Agricultural Research Service, Food Surveys Research Group; 2004. [Google Scholar]

2. Chang CC, Lin CJ. LIBSVM: a library for support vector machines. 2001 software available at http://www.csie.ntu.edu.tw/cjlin/libsvm.

3. Jain A, Farrokhnia F. Unsupervised texture segmentation using gabor filters. Pattern recognition. 1991;24(12):1167–1186. [Google Scholar]

4. Shi J, Malik J. Normalized cuts and image segmentation. IEEE Transactions on pattern analysis and machine intelligence. 2000;22(8):888–905. [Google Scholar

5. Chan T, Sandberg B, Vese L. Active contours without edges for vector-valued images. Journal of Visual Communication and Image Representation. 2000;11(2):130–141. [Google Scholar]

6. Woo I, Otsmo K, Kim S, Ebert DS, Delp EJ, Boushey CJ. Automatic portion estimation and visual refinement in mobile dietary assessment. Proceedings of the IS&T/SPIE Conference on Computational Imaging VIII; San Jose, CA. January 2010. [PMC free article] [PubMed] [Google Scholar]

7. Mariappan A, Bosch M, Zhu F, Boushey CJ, Kerr DA, Ebert DS, Delp EJ. Personal dietary assessment using mobile devices. Proceedings of the IS&T/SPIE Conference on Computational Imaging VII; San Jose, CA. January 2009. [PMC free article] [PubMed] [Google Scholar]

2.3 PROBLEM STATEMENT DEFINITION

High-Calorie food intake can be harmful and result in obesity, which is a preventable medical condition that causes abnormal accumulation of fat in the body. It can result in numerous diseases such as obesity, diabetes, cholesterol, heart attacks, blood pressure, and other diet-related ailments. In order to deal with such problems, people are inclined towards making a difference in their diet plans by paying more attention to what type of food they are consuming. Diet management is a key concern among individuals belonging to different age groups. However, one major challenge in diet management is maintaining a balance between what one eats and how one monitors his/her food consumption. The immense increase in ailments such as high cholesterol, blood pressure, strokes, etc. demands nutritional and diet management for which people resort to expensive nutrition therapies.

1. Who does the problem affect?

• Fitness enthusiasts who are not taking sufficient nutrition intake.

2. What is the issue?

• The issue is fitness freaks work more but do not get proper nutrients which leads to bad metabolism and causes health-related issues.

3. What is the impact of this issue?

• Lack of nutrition.

• Weaker immune system.

• Stress, tiredness, illness.

4. What would happen if we didn't solve the problem?

If we don't fix this issue it may cause various health related issues that include weight loss, lack of nutrition, and vitamin and mineral deficiency. These issues lead to low BMI levels. On the other hand, untreated obesity leads to high blood pressure, and excess cholesterol ultimately leads to heart diseases.

5. What would happen when it is fixed?

• Higher immunity level.

• Normal blood pressure.

• Rich metabolism levels.

## 6. Why is it important that we fix this problem?

Our body requires enough calories, nutrients, and minerals as much as it has burned during work, so when the person fails to take sufficient nutrients their metabolism will not be proper which may lead to many health issues, so it is important to fix this problem which leads a healthy life.

Solution:

The aim of this project is to create a fitness tracker which motivates users to track their diet and follow their diet without the eventual abatement. The classification of fruits is planned to be based on Convolutional Neural Network. Primarily, the model is trained using a training data set of several fruits to be able to accurately measure the calories, sugar, fibre and proteins present in a particular fruit. Furthermore, based on the image taken by the user, real time processing is done and uploaded to a custom-made website.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas:
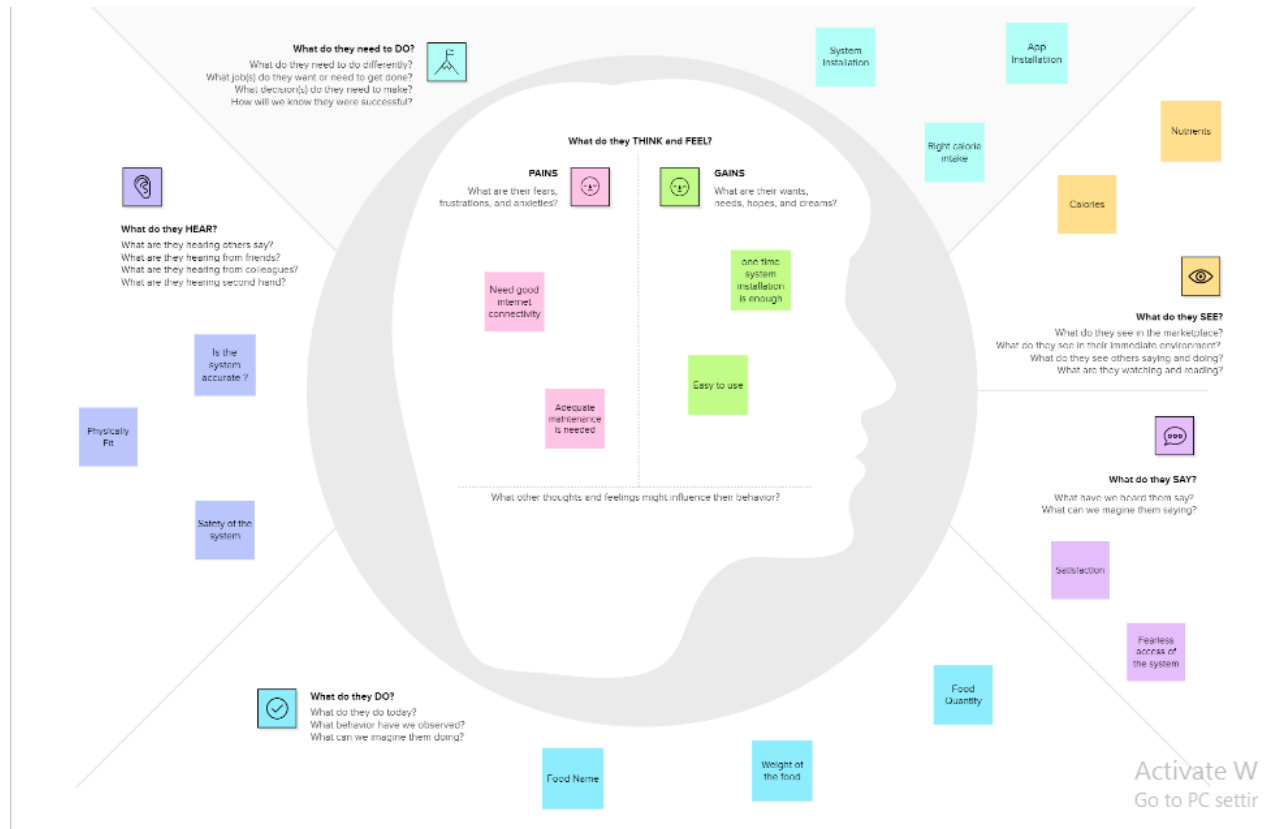
3.2 Ideation & Brainstorming:

Problem Statement

High-Calorie food intake can be harmful
and result in obesity, which is a preventable
medical condition that causes abnormal
accumulation of fat in the body. It can result
in numerous diseases such as obesity,
diabetes, cholesterol, heart attacks, blood
pressure, and other diet-related ailments. In
order to deal with such problems, people
are inclined towards making a difference in
their diet plans by paying more attention to
what type of food they are consuming. Diet
management is a key concern among
individuals belonging to different age
groups. However, one major challenge in
diet management is maintaining a balance
between what one eats and how one
monitors his/her food consumption. The
immense increase in ailments such as high
cholesterol, blood pressure, strokes, etc.
demands nutritional and diet management
for which people resort to expensive
nutrition therapies.

❷

Brainstorm

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

🕐 10 minutes

Varun

| Calorie Tracking | Nutrition |
| Track nutrition goal | Protein |

Vignesh

| Food identification | Food recipes |
| Exercise | Hydration |

Gopinath

| Diet plan | Weight goals |
| Macro nutrients | Calorie Surplus & Deficit |

Akash

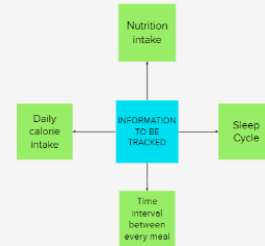| Daily protein intake | Anti-oxidants |
| Diet reminder | Vitamins |

❸

Group ideas

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

🕐 20 minutes

3.3 Proposed Solution:

Project team shall fill the following information in proposed solution template.

S.NO.	PARAMETER	DESCRIPTION
1	Problem Statement (Problem to be solved)	Filling the gap of not knowing the nutrients intake and helping to maintain a proper balanced consumption for the customers/users.
2	Idea / Solution description	A web based application that allows user to retrieve the nutritional facts of a food item by adding an image of it.
3	Novelty / Uniqueness	• Web based easy to use interface. • Provides an image based facts retrieval of food. • Suggestion based on the facts. • Basic details and guidance based on the user profile.
4	Social Impact / Customer Satisfaction	With the assistance of the data obtained, users get to maintain a healthy body, which makes them feel confident. In addition, it boosts their energy and stamina.
5	Business Model (Revenue Model)	• Connecting to hospitals and centres that provide support for the user's. • Subscription based plan for users to unlock all features. • Incorporating advertisements of all

		categories.
		• Providing online resources for customers.
6	Scalability of the Solution	• Making a user-friendly interface and making it all platform compatible.
		• Providing rewards for usage and sharing of application.
		• Using client data and feedback to improvise.
		• Collaborating with other parties for larger scale usage.

3.4 Problem Solution fit:

PARAMETER DESCRIPTION	PARAMETER DESCRIPTION
PROBLEM STATEMENT	Major challenge in diet management is maintaining a balance between what one eats and how one monitors his/her food consumption. The immense increase in ailments such as high cholesterol, blood pressure, strokes, etc. demands nutritional and diet management for which people resort to expensive nutrition therapies.
SCALABILITY OF THE SOLUTION	Filling the gap of not knowing the nutrients intake and helping to maintain a proper balanced consumption for the customers/users.
IDEA/SOLUTION DESCRIPTION	An application that allows user to retrieve the nutritional facts of a food item by adding an image of it.

4. REQUIREMENT ANALYSIS:

4.1 Functional requirement:

Following are the functional requirements of the proposed solution.

FR NO	FUNCTIONAL REQUIREMENT (EPIC)	SUB REQUIREMENT (STORY / SUB-TASK)
FR-1	User Interaction	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. In the web interface, ● 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. ● All the registered users will be verified with either email or mobile number based on their interest in giving their information, but the verification is a must one. ● For non-registered users, the user can visit the website free of cost and can check the nutrient value in the fruits and vegetables, and also can view the common practices for fitness.
FR-2	User Management	Creating a group of people, who are willing to befit in their health and making them organized in a sample place, through which they can collaborate

|		and also can achieve their goals with others, by encouraging each other. The application Date 17 October 2022 Team ID PNT2022TMID46718 Project Name AI-powered Nutrition Analyzer for Fitness Enthusiasts Maximum Marks 4 Marks 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. On an periodic interval (like once in month), we need to interact one to one with each and every user to solve the queries
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:

Following are the non-functional requirements of the proposed solution

FR NO	Non-Functional Requirement	Description
NFR-1	Usability	60% of the internet users are mobile users, and most of them are only using some common application for communicating based on the features they offer. So the application should be easily accessible by users and also it should have the ability to report an issue by the user to solve it as soon as possible.
NFR-2	Security	While logging the application, the data is encrypted and highly secured which can avoid data plagiarism. Authentication and authorization are to be done properly through the application.
NFR-3	Reliability	Application can offer you to stay focused on your diet plan. It offers to maintain your calories in your desired food. It shows quite accurately calories for the user that makes to sustain in healthy lifestyle.
NFR-4	Performance	Performance of the application should be high enough to maintain the user in the application and also to get new users. Performance can be increased by using optimized code and also reducing the redirects and also can by DSA (Data Structures and Algorithms).

NFR-5	Availability	Even though it is a good application for registered users, it has the ability to offer minimum functionality to the nonregistered users and also to increase the audience base.
NFR-6	Scalability	The application should be as much as scalable, in order to increase the number of users based on their interest.

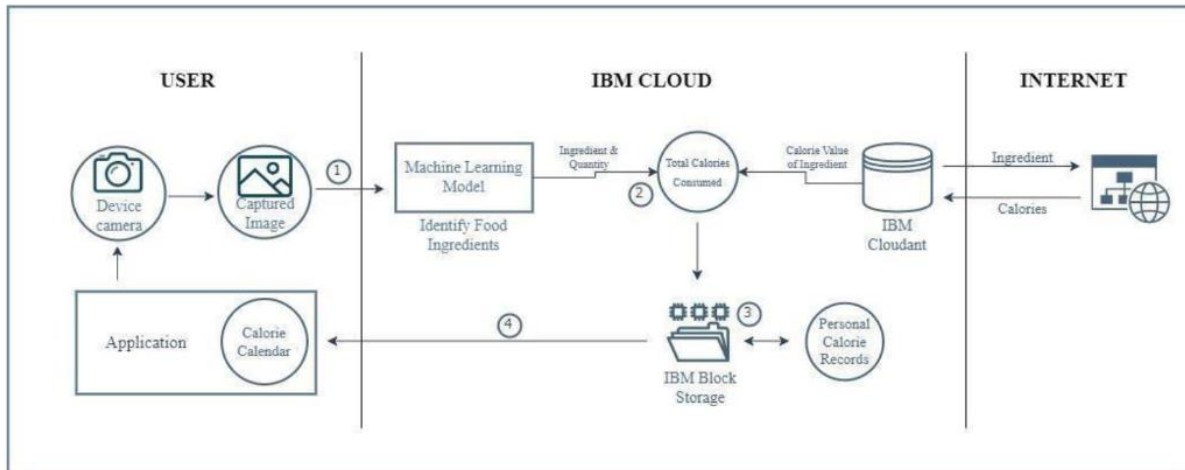# 5. PROJECT DESIGN:

5.1 Data Flow Diagrams:
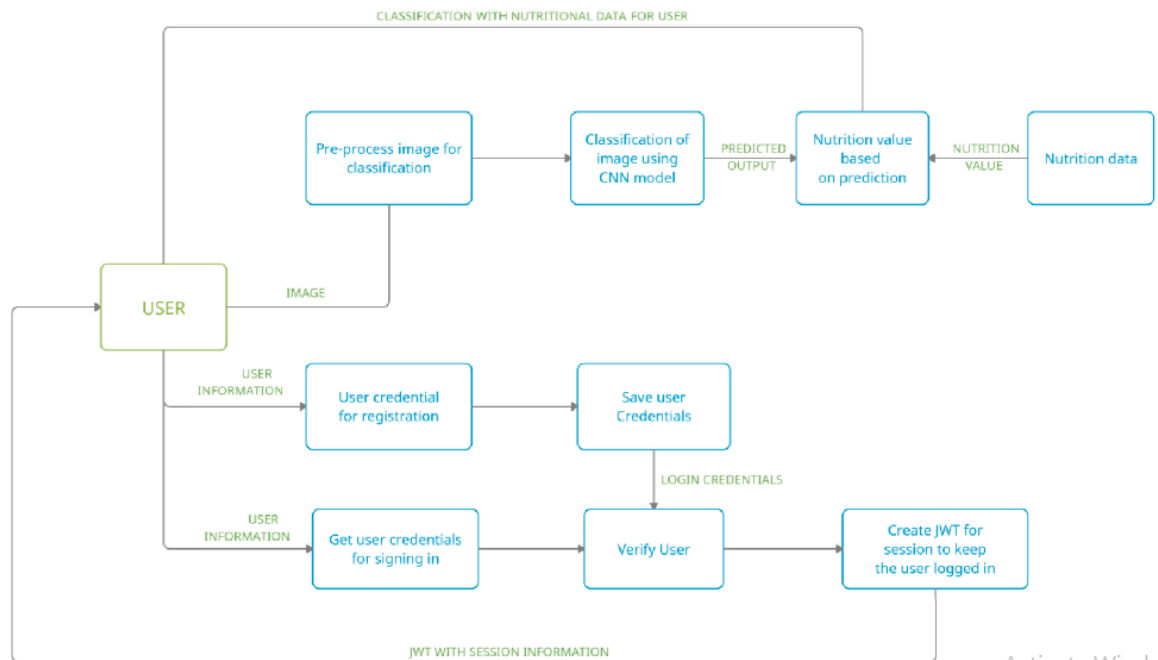
5.2 Solution & Technical Architecture:

Solution Architecture:

```
                    ┌──────────────┐
                    │    Data      │
                    │  Collection  │
                    └──────┬───────┘
                           │
                           ▼
                    ┌──────────────┐
                    │Pre-Processing│
                    └──────┬───────┘
                           │
                           ▼
                    ┌──────────────┐
                    │   Feature    │
                    │  Extraction  │
                    └──────┬───────┘
                           │
                           ▼
 ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
 │ Test Dataset │◄──│   Feature    │──►│Train Dataset │
 │              │   │  Selection   │   │              │
 └──────┬───────┘   └──────────────┘   └──────┬───────┘
        │                                      │
        │           ┌──────────────┐           ▼
        └──────────►│   Evaluate   │◄──┌──────────────┐
                    │  Classifier  │   │Train Classifier│
                    └──────────────┘   └──────────────┘
```
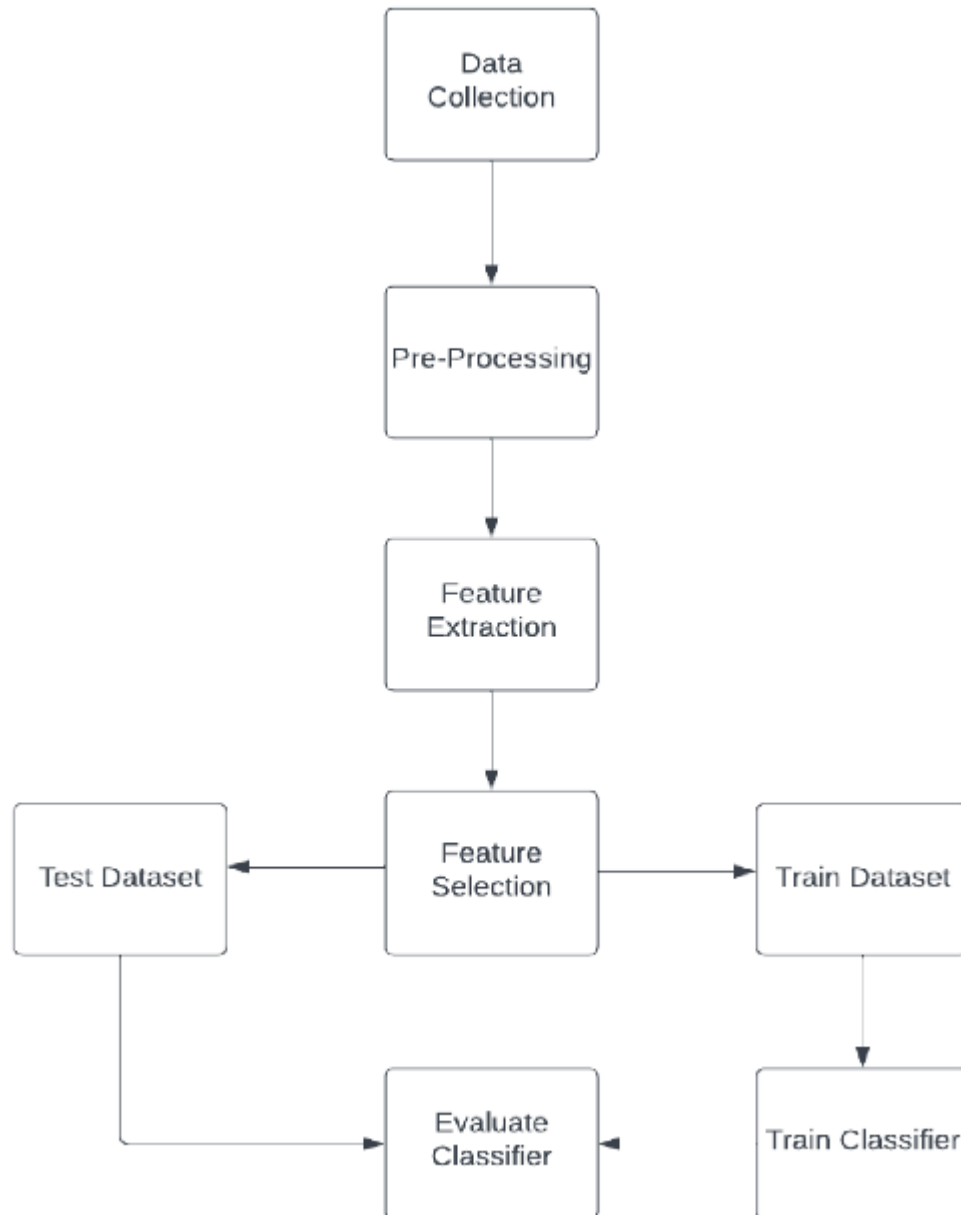
Technical Architecture:

5.3 User Stories:

User	Type Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer	Application	USN-1	As a user I installed the application for day to day leaf disease detection and recognize it.	My app will be installed in home screen.	High	Sprint-1

		USN-2	As a user, I can register for the application identifying diseases at early stage	I can access my account /dashboard	High	Sprint-1
		USN-3	As a user I will detect the plant once I have registered for the particular process	I can register and access the dashboard with application account	Medium	Sprint-2

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	Registration	USN-1	As an biogeography, I can register for the application by entering my email, password, and confirming my password.	2	High	Varun K Vignesh K
Sprint-1	User Confirmation	USN-2	As an biogeography, I will receive confirmation email once I have registered for the application	1	Medium	Gopinath P Akash K
Sprint-1	Login	USN-3	As an biogeography, I can log into the application by entering email & password	2	High	Varun K Vignesh K Gopinath P
Sprint-2	Data Collection	USN-1	Download the dataset used in Digital Naturalist – AI Enabled tools for Biodiversity Researchers	2	High	Varun K Vignesh K Gopinath P
Sprint-2	Image Preprocessing	USN-1	Improving the image data that suppresses unwilling distortions or enhances some image featuresimportant for further processing,although performing some geometric transformations of images like rotation, scaling, etc.	1	High	Vignesh K Gopinath P
Sprint-3	Getting started with Convolutional Neural Network	USN-1	Neural network are integral for teaching computers to think and learn by classifying information, similar to how we as humans learn. With neural networks, the software can learnto recognize images, for example. Machine scan also make predictions and decisions with a high level of accuracy based on data inputs.	2	High	Akash K Vignesh K Gopinath P

Sprint-2	Image Preprocessing	USN-1	Improving the image data that suppresses unwilling distortions or enhances some image featuresimportant for further processing,although performing some geometric transformations of images like rotation, scaling, etc.	1	High	Vignesh K Gopinath P
Sprint-3	Getting started withConvolutional Neural Network	USN-1	Neural network are integral for teaching computers to think and learn by classifying information, similar to how we as humans learn. With neural networks, the software can learnto recognize images, for example. Machines can also make predictions an decisions with a high level of accuracy based on data inputs.	2	High	Varun K Vignesh K Gopinath P Akash K
Sprint-3	Evaluation and model saving	USN-1	well a model behaves after each iteration of optimization. An accuracy metric is used to measure the algorithm's performance in an interpretableway. The accuracy of a model is usually determined after the model parameters and is calculated	1	Medium	Vignesh K Gopinath P

Acti

			in the form of a percentage. Saving The Model get weights , set weights .			
Sprint-4	Application Building	USN-2	After the model is built, we will be integrating it to a web application so that normal userscan also use it. The users need to give the images of species	1	High	Varun K Vignesh K
Sprint-4	Train the Model on IBM	USN-3	Build Deep learning model and computer vision Using the IBM cloud.	2	High	Varun K Vignesh K Gopinath P Akash K

6.2 Sprint Delivery Schedule:

Sprint	Total Story Points	Duration	Sprint Start Date	Story Points Completed (as on Planned End Date)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	5 Days	30 Oct 2022	2 Nov 2022	20	31 Oct 2022
Sprint-2	20	5 Days	3 Nov 2022	7 Nov 2022	20	8 Nov 2022
Sprint-3	20	5 Days	8 Nov 2022	12 Nov 2022	20	13 Nov 2022
Sprint-4	20	6 Days	13 Nov 2022	18 Nov 2022	20	19 Nov 2022

6.3 Reports from JIRA:

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

7 CODING & SOLUTIONING:

SCREENSHOT:

8 TESTING

8. SYSTEM TESTING

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub-assemblies, assemblies and/or a finished product. It is the process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of test. Each test type addresses a specific testing requirement.

8.1 TYPES OF TESTS

8.1.1 Unit testing

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .it is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

8.1.2 Integration testing

Integration tests are designed to test integrated software components to determine if they actually run as one program. Testing is event driven and is more concerned with the basic outcome of screens or fields. Integration tests demonstrate that although the components were individually satisfaction, as shown by successfully unit testing, the combination of components is correct and consistent. Integration testing is specifically aimed at   exposing the problems that arise from the combination of components.

8.1.3 Functional test

Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals.

Functional testing is centered on the following items:

Valid Input   : identified classes of valid input must be accepted.

Invalid Input   : identified classes of invalid input must be rejected.

Functions   : identified functions must be exercised.

Output   : identified classes of application outputs must be exercised.

Systems/Procedures: interfacing systems or procedures must be invoked.

Organization and preparation of functional tests is focused on requirements, key functions, or special test cases. In addition, systematic coverage pertaining to identify Business process flows; data fields, predefined processes, and successive processes must be considered for testing. Before functional testing is complete, additional tests are identified and the effective value of current tests is determined.

8.1.4 System Test

System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. An example of system testing is the configuration-oriented system integration test. System testing is based on process descriptions and flows, emphasizing pre-driven process links and integration points.

8.1.5 White Box Testing

White Box Testing is a testing in which in which the software tester has knowledge of the inner workings, structure and language of the software, or at least its purpose. It is purpose. It is used to test areas that cannot be reached from a black box level.

8.1.6 Black Box Testing

Black Box Testing is testing the software without any knowledge of the inner workings, structure or language of the module being tested. Black box tests, as most other kinds of tests, must be written from a definitive source document, such as specification or requirements document, such as specification or requirements document. It is a testing in which the software under test is treated, as a black box .you cannot "see" into it. The test provides inputs and responds to outputs without considering how the software works.

8.2 Unit Testing:

Unit testing is usually conducted as part of a combined code and unit test phase of the software lifecycle, although it is not uncommon for coding and unit testing to be conducted as two distinct phases.

8.2.1 Test strategy and approach

Field testing will be performed manually and functional tests will be written in detail.

8.2.2 Test objectives

- All field entries must work properly.

- Pages must be activated from the identified link.

- The entry screen, messages and responses must not be delayed.

8.2.3 Features to be tested

- Verify that the entries are of the correct format

- No duplicate entries should be allowed

- All links should take the user to the correct page.

8.3 Integration Testing

Software integration testing is the incremental integration testing of two or more integrated software components on a single platform to produce failures caused by interface defects. The task of the integration test is to check that components or software applications, e.g. components in a software system or – one step up – software applications at the company level – interact without error.

Test Results: All the test cases mentioned above passed successfully. No defects encountered.

8.4 Acceptance Testing

User Acceptance Testing is a critical phase of any project and requires significant participation by the end user. It also ensures that the system meets the functional requirements.

Test Results: All the test cases mentioned above passed successfully. No defects encountered.

9   RESULTS

10 ADVANTAGES & DISADVANTAGES:

ADVANTAGES

➢ Useful in determining the and recognizing value of the different food types.

➢ By effectively implementing this algorithm, we can identify the Calorie values.

➢ Image quality is high.

➢ High accuracy

DISADVANTAGES:

➢ Less accuracy

➢ Less sensitivity

➢ Less specificity

➢ High computation time

11 CONCLUSION :

We designed CNN based algorithm for predicting nutrion content present in the food items ,calorie level of food items ,we take fruit food items for detect the nutrion content present in them image we present the fruit detection and recognition system that we built, using deep convolutional neural network for the recognition of food images from the 8-class dataset that we acquired using Google

image searches, while keeping the model training time low to enable faster fine-tuning. Training the model with different epochs further improvement in test accuracy data expansion, which could also be achieved by collecting more training data or by optimizing the architecture and hyper-parameters of the network, considering overtraining problem at the same time. We have written a function which determines calories based on the fruit detected by taking in consideration the average calorie value of that fruit.

12 FUTURE WORK

13 APPENDIX:

Source Code:

```python
import os
from flask import Flask, render_template, request, flash, redirect
import numpy as np
```

```python
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
import cv2
from tqdm import tqdm
from PIL import Image
import io


import tensorflow as tf
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from sklearn.utils import shuffle
from sklearn.model_selection import train_test_split
from tensorflow.keras.applications import EfficientNetB2
from keras.layers import GlobalAveragePooling2D, Dropout, Dense
from keras.models import Model
from tensorflow.keras.callbacks import EarlyStopping, ReduceLROnPlateau, TensorBoard, ModelCheckpoint
from sklearn.metrics import classification_report, confusion_matrix
from IPython.display import display, clear_output
import ipywidgets as widgets


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

%Directory setting

```
fpath = '/content/drive/My Drive/nutrion analysis/new dataset'
random_seed = 42


categories = os.listdir(fpath)
categories = categories[:20]
print("List of categories = ",categories,"\n\nNo. of categories = ", len(categories))
% image loading and labeling
def load_images_and_labels(categories):
    img_lst=[]
    labels=[]
    for index, category in enumerate(categories):
        for image_name in os.listdir(fpath+"/"+category):
            img = cv2.imread(fpath+"/"+category+"/"+image_name)
            img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)


            img_array = Image.fromarray(img, 'RGB')


            #resize image to 227 x 227 because the input image resolution for AlexNet
is 227 x 227
            resized_img = img_array.resize((227, 227))


            img_lst.append(np.array(resized_img))


            labels.append(index)
    return img_lst, labels
```

```python
images, labels = load_images_and_labels(categories)
print("No. of images loaded = ",len(images),"\nNo. of labels loaded = ",len(labels))
print(type(images),type(labels))
```

%model summary

```python
model=Sequential()
```

```python
#1 conv layer
model.add(Conv2D(filters=96,kernel_size=(11,11),strides=(4,4),padding="valid",activation="relu",input_shape=(227,227,3)))
```

```python
#1 max pool layer
model.add(MaxPooling2D(pool_size=(3,3),strides=(2,2)))
```

```python
model.add(BatchNormalization())
```

```python
#2 conv layer
model.add(Conv2D(filters=256,kernel_size=(5,5),strides=(1,1),padding="valid",activation="relu"))
```

```python
#2 max pool layer
model.add(MaxPooling2D(pool_size=(3,3),strides=(2,2)))
```

```python
model.add(BatchNormalization())
```

```python
#3 conv layer
model.add(Conv2D(filters=384,kernel_size=(3,3),strides=(1,1),padding="valid",activation="relu"))

#4 conv layer
model.add(Conv2D(filters=384,kernel_size=(3,3),strides=(1,1),padding="valid",activation="relu"))

#5 conv layer
model.add(Conv2D(filters=256,kernel_size=(3,3),strides=(1,1),padding="valid",activation="relu"))

#3 max pool layer
model.add(MaxPooling2D(pool_size=(3,3),strides=(2,2)))

model.add(BatchNormalization())

model.add(Flatten())

#1 dense layer
model.add(Dense(4096,input_shape=(227,227,3),activation="relu"))

model.add(Dropout(0.4))

model.add(BatchNormalization())
```

```python
#2 dense layer
model.add(Dense(4096,activation="relu"))

model.add(Dropout(0.4))

model.add(BatchNormalization())

#3 dense layer
model.add(Dense(1000,activation="relu"))

model.add(Dropout(0.4))

model.add(BatchNormalization())

#output layer
model.add(Dense(20,activation="softmax"))

model.summary()
```

% compile CNN model and accuracy

```python
model.compile(optimizer="adam", loss="sparse_categorical_crossentropy", metrics=["accuracy"])
```

%train the model

```python
model.fit(x_train, y_train, epochs=100)
```

%model save

```python
model_name = 'trained_model.h5'
```

```
model.save(model_name, save_format='h5')
```

%loss accuracy

```
loss, accuracy = model.evaluate(x_test, y_test)
```

```
print(loss,accuracy)
```

GITHUB :

https://github.com/IBM-EPBL/IBM-Project-44184-1660723167

PROJECT DEMO LINK :

https://youtu.be/HnfOg_NO4oQ