AI-powered Nutrition Analyzer for Fitness Enthusiasts

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CHAPTER 1

INTRODUCTION

ABSTRACT:

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 analysisis the process of determining the nutritional content of food. It is avital part of analytical chemistry that provides information about the chemical composition, processing, quality control and contamination of food.

PROJECT DESCRIPTION

The main aim of the project is to build a model which is used for classifying the fruit depends on the different characteristics like color, 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, Fiber, Protein, Calories,etc.).

TECHNOLOGIES USED:

Python, CNN, IBM Cloud, IBM Watson, IBM Cloudant DB, Deep Learning, Python- Flask

PROJECT FLOW:

The user interacts with the UI (User Interface) and give theimage as input. Then the input image is then pass to our flask application, And finally with the help of the model which we build we willclassify the result and showcase it on the UI..

CHAPTER 2

LITERATURE SURVEY:

Nutrition is vital to the growth of the human body. Nutritional analysis guarantees that the meal meets the appropriate vitamin and mineral requirements, and the examination of nutrition in food aid in understanding the fat proportion, carbohydrate dilution, proteins, fiber, sugar, and so on. Another thing to keep in mind is not to exceed our daily calorie requirements. If this limit is surpassed, we may become fat.

Neutrino: Artificial Intelligence Nutrition App. As the name implies, the app provides nutrition-based analytics and data to its customers and is quickly becoming a prominent platform for offering AI fitness services. It deploys predictive analysis for personalized data compilation using mathematical and natural language processing (NLP) models.

Furthermore, it shares nutrition-related data with its partners via SDK and API integrationto improve its services and product offerings. It Is an Israel-basedfirm created in 2011 that allows pregnant women to customize their body's nutritional requirements. This software collaborated with IBM's natural language capability to provide 24-hour assistance and dietary recommendations. MyFitnessPal App creates a daily food diary for you by recognizing the food from photos you shoot. You take a picture, dial in data such as whether you are eating breakfast or lunch and add a quick text label, and the app estimates the calorie content. It does a pretty good job, although its estimate can be a bit unpredictable. It also needs a network connection, which is something to think about when eating out.

RESULT AND DISCUSSION:

This model will be useful for every category peopleirrespective of age and gender. Using this model we'll know the exact amount of nutritional content in the food we have which is very useful asit isvery important to take care of one's health

CHAPTER 3

IDEATION AND PROPOSED SOLTUION

Customer Problem Statement :

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 analysisis the process of determining the nutritional content of food. It is avital part of analytical chemistry that provides information about the chemical composition, processing, quality control and contamination of food.

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The user interacts with the UI (User Interface) and give theimage as input. Then the input image is then pass to our flask application, And finally with the help of the model which we build we willclassify the result and showcase it on the UI.

I am	**Mr.X**	**Mr.X , fruits, food,etc.**

I’m trying to	**Have nutritious food**	**Sugar,Protein,Carbs,Fat.etc.**
but	**I’m unable to analyze**	**Lack of analyzing capacity**
because	**I don't know the nutrition values**	**Don’t know how to analyze with AI, lack of knowledge in AI.**
which makes me feel	**Lazy about choosing right food**	**Can’t analyze due to unknown facts about the nutrition values.**

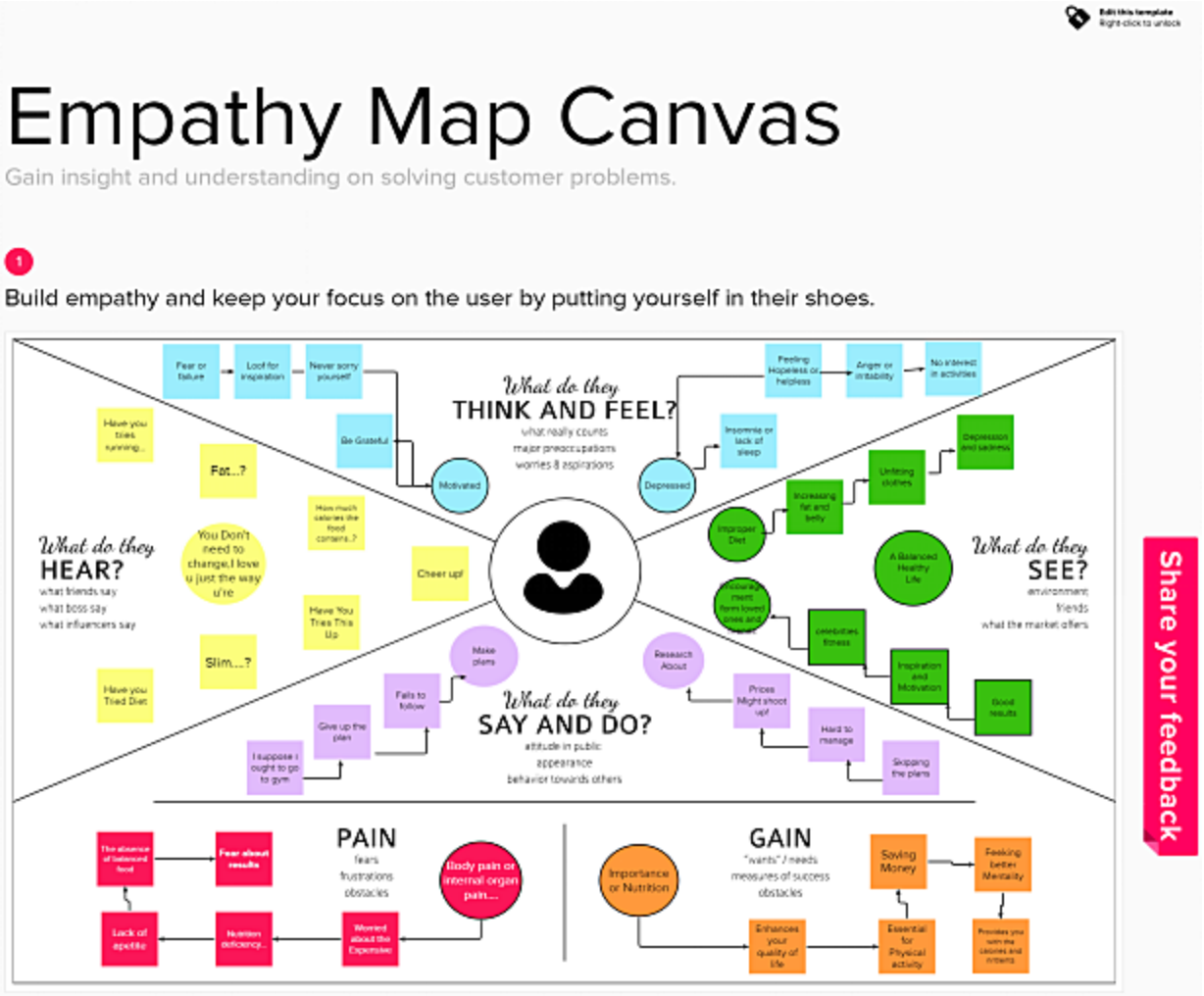
Problem Statement (PS)	**I am (Customer)**	**I’m trying to**	**But**	**Because**	**Which makes me feel**
PS-1	X	**Have nutritious food**	**Have nutritious food**	**Have nutritious food**	**Have nutritious food**
PS-2	Y	**Have nutritious food**	**Have nutritious food**	**Have nutritious food**	**Have nutritious food**

Empathy Map Canvas:

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user’s behaviours and attitudes.

It is a useful tool to helps teams better understand their users.

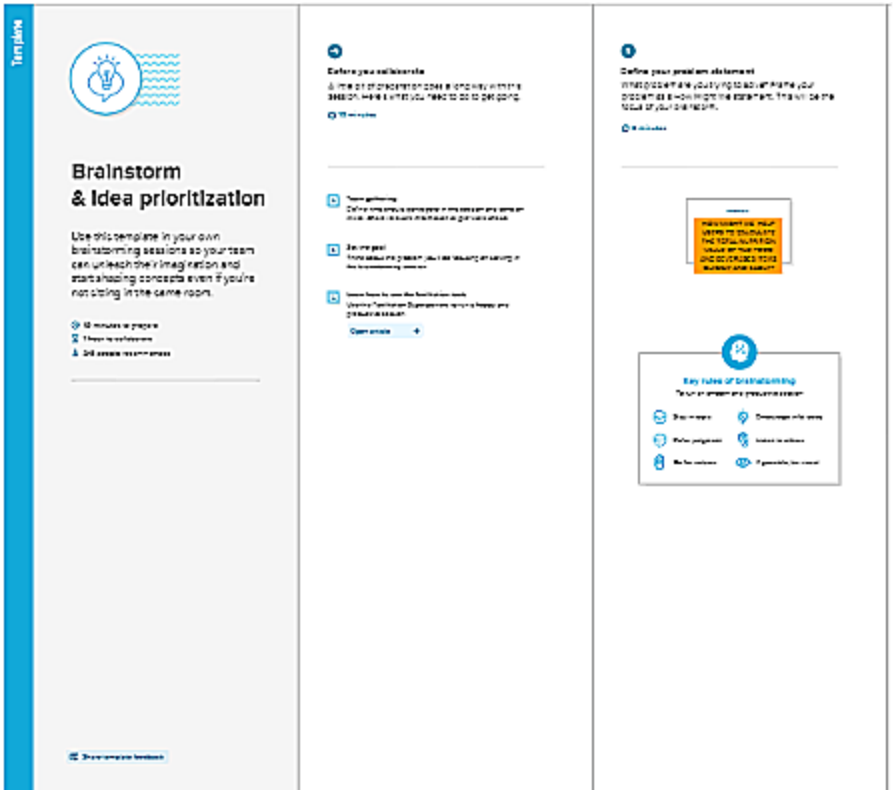
Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.



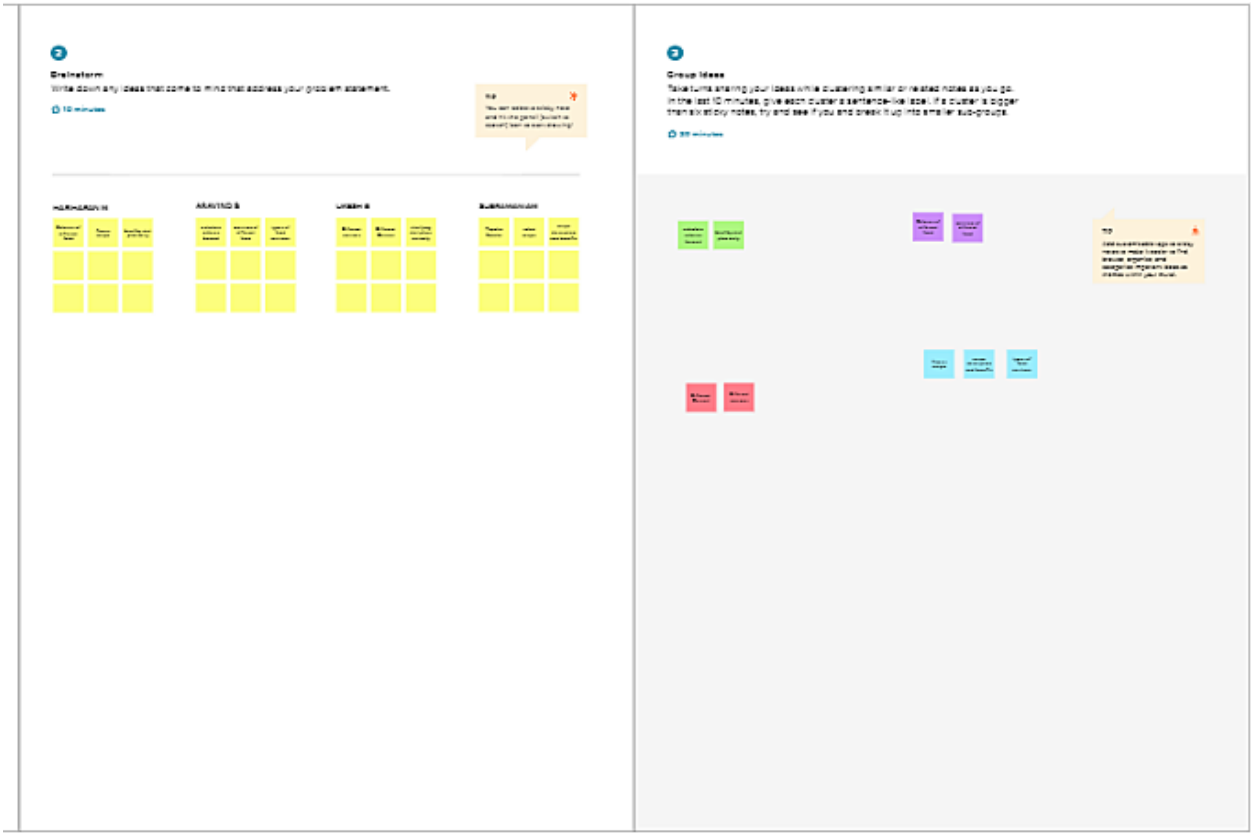
Brainstorm & Idea Prioritization

The main aim of the project is to build a model which is used for identifying the fruit depends on the different characteristics like colour, shape, texture etc using image processing. 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

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



Step-2: Brainstorm, Idea Listing and Grouping



Step-3: Idea Prioritization

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 depends on the different characteristics like colour, shape, texture etc using image processing. 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.	Idea / Solution description	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. The model analyses the image and detects the nutrition based on the fruits like (Sugar, Fibre, Protein, Calorie intake, etc.). The above idea is achieved by using the Convolution Neural Network (CNN) . It is used to pick the raw pixels present in the image . Fruit Recognition using Colour and Texture Features .
3.	Novelty / Uniqueness	The application has several unique features. The main feature is that the user need not have to visit or consult a Nutritionist (or) a Dietician to follow a fit and healthy diet. This application has the feature of analysing the entire nutritional content of fruits and vegetables by simply scanning them. It provides for a personalized dietary requirement for individuals who have limited preferences while

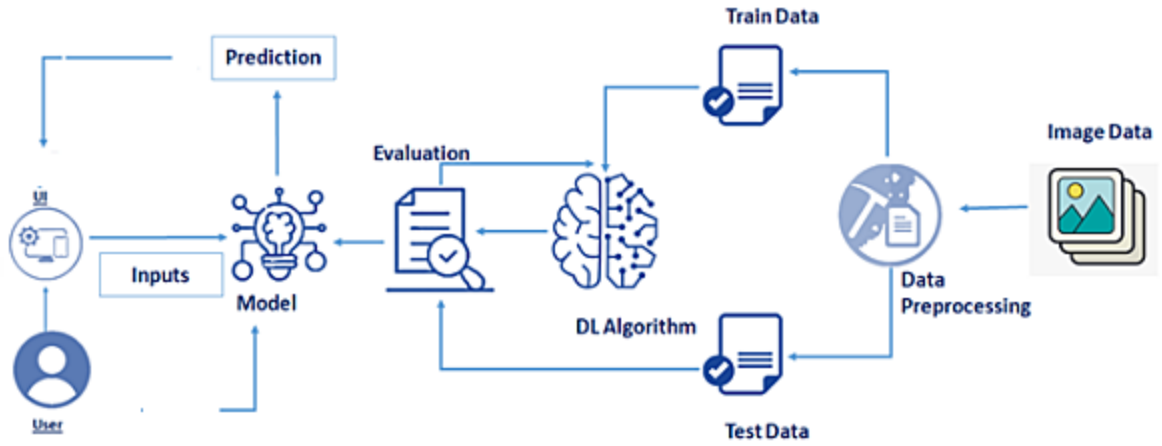
		choosing food.
4.	Social Impact / Customer Satisfaction	This will acquire knowledge and provide information about nutrition. Now a days, no one follows the diet plan. Providing this information, they come to know about the nutrition present in each food item. It is used to schedule a diet plan by taking the image of a food item and if we send it, we can get information about each food nutrition 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 word 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	Artificial intelligence (AI) can be used to predict investment outcomes quickly and effectively, as well as to devise strategies or establish long-term goals. 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

Solution Architecture:

1. The main aim of the project is to build a model which is used for identifying the fruit depends on the different characteristics like colour, shape, texture etc using image processing. 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



CHAPTER 4

REQUIREMENT ANALYSIS

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form,IBM CLOUD
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Upload Image of the food	Existing image should be uploaded in the web api
FR-4	Get the results declared by the analyzer	View data

Non-functional Requirements:

Following are the non-functional requirements of the proposed solution.

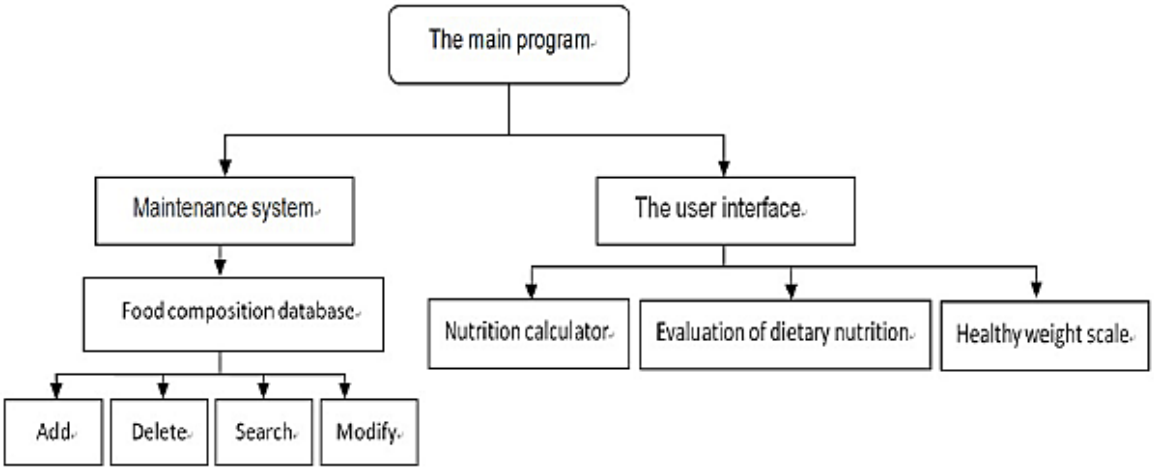
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Used many times for several food images
NFR-2	**Security**	Only registered users can access
NFR-3	**Reliability**	Always reliable since the model sis running in the IBM cloud
NFR-4	**Performance**	High performance
NFR-5	**Availability**	Always available in Cloud
NFR-6	**Scalability**	High

CHAPTER 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.



User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail		Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password		High	Sprint-1
	Dashboard					
Customer (Web user)	Accessory	USN-6	Able to choose the images for classification	Accepted	high	1.0

Customer Care Executive	Executive	USN-7	Can upload images	Accepted	low	1.0
Administrator	Admin	USN-8	Can access pictures	Accepted	high	1.0

CHAPTER 6

SPRINT PLANNING

SPRINT	FUNCTIONAL REQUIREMENT	USER STORY NUMBER	USER TASK POINTS	USER TASK	PRIORITY	TEAM MEMBERS
SPRINT 1	Importing libraries, initial code	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	HARIHARAN.M, UKESH.B
SPRINT 1	Dataset download	USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	HARIHARAN.M, UKESH.B
SPRINT 2	Load the data set	USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	ARVIND,GOUTHAM KUMAR
SPRINT 2	Load the image samples	USN-4	As a user, I can register for the application through Gmail		Medium	SUBRMANIAM
SPRINT 3	Access the local disks	USN-5	As a user, I can log into the application by entering email & password		High	HARIHARAN
SPRINT 4	Define and train the model	USN-6	Able to choose the images for classification	Accepted	high	ARVIND,UKESH

SPRINT 4	IBM cloud training	USN-7	Can upload images in cloud and see the model running	Accepted	low	GOUTHAM,SUBRAMANIAM
SPRINT 4	Test	USN-8	Can access pictures	Accepted	high	HARIHARAN. M , ARVIND. V
COMPLETION	----------	---	----------	----------	---	----------

Sprint	**Functional Requirement (Epic)**	**User Story Number**	**User Story / Task**	**Story Points**	**Priority**	**Team Members**
Sprint-1	Registration	USN-1	As a user, I can register for the application.	2	High	Arvind
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	Low	Ukesh
Sprint-2		USN-3	As a user, I can register for the application through IBM watson	2	Low	Gowtham Kumar
Sprint-1		USN-4	As a user, I can upload the image and get the result for classification	2	Medium	Hariharan
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	Subramaniam

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	29 Oct 2022	20	29 Oct 2022

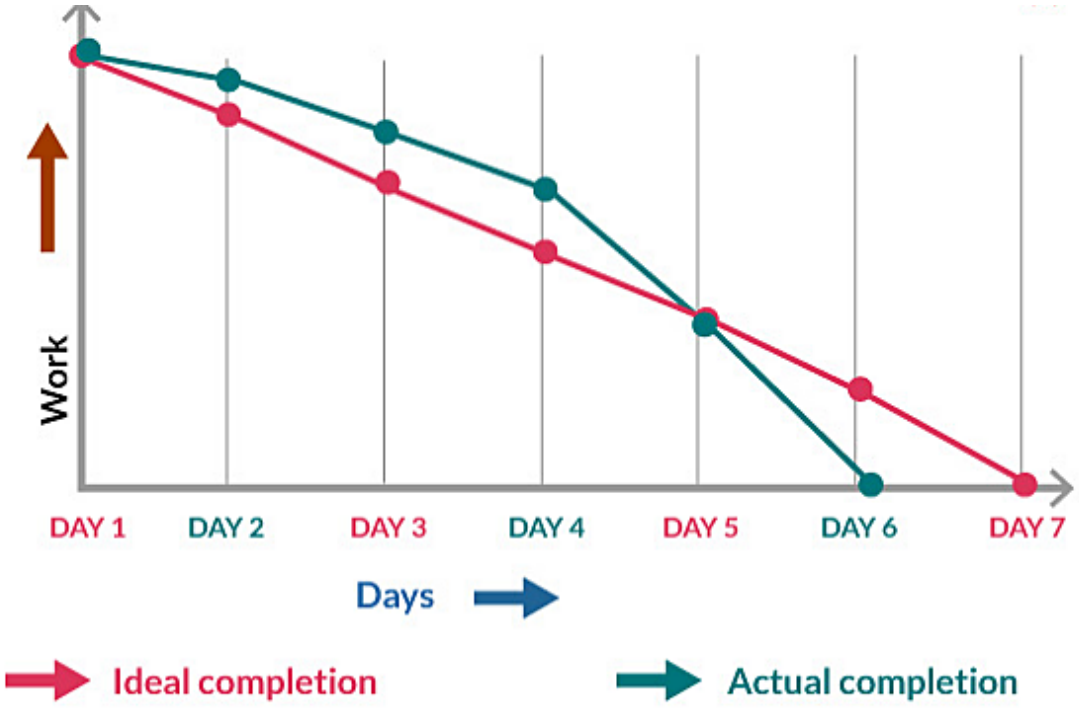
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

Project Tracker, Velocity & Burndown Chart: (4 Marks)

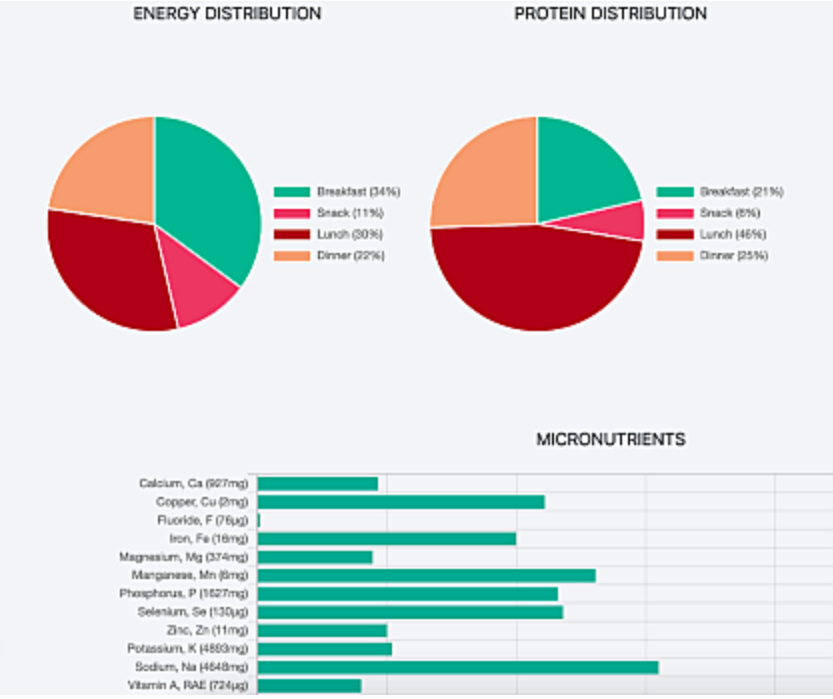
Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let’s calculate the team’s average velocity (AV) per iteration unit (story points per day)

Burndown Chart:



Sprint planning Process:



CHAPTER 7

CODING AND SOLUTION

Coding:

```
!conda install --yes keras
```

Collecting package metadata (current_repodata.json): ...working... done
Solving environment: ...working... done

All requested packages already installed.

Retrieving notices: ...working... done

In [28]:

```
!conda install --yes tensorflow
```

Collecting package metadata (current_repodata.json): ...working... done
Solving environment: ...working... done

All requested packages already installed.

Retrieving notices: ...working... done

In [29]:

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

In [30]:

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

In [31]:

```
test_datagen=ImageDataGenerator(rescale=1./255)
```

In [32]:

```
x_train=train_datagen.flow_from_directory(r'C:\Users\HARIHARAN\PycharmProjects\AI
```

```
Analyzer for fitness enthusiasts\TRAIN_SET',target_size=(64,
64),batch_size=5,color_mode='rgb',class_mode='sparse')
```

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

In [33]:

```
x_test=test_datagen.flow_from_directory(r'C:\Users\HARIHARAN\PycharmProjects\AI
Analyzer for fitness enthusiasts\TEST_SET',target_size=(64,
64),batch_size=5,color_mode='rgb',class_mode='sparse')
```

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

In [34]:

```
print(x_train.class_indices)
```

```
{'APPLES': 0, 'BANANA': 1, 'ORANGE': 2, 'PINEAPPLE': 3, 'WATERMELON': 4}
```

In [35]:

```
print(x_test.class_indices)
```

```
{'APPLES': 0, 'BANANA': 1, 'ORANGE': 2, 'PINEAPPLE': 3, 'WATERMELON': 4}
```

In [36]:

```
from collections import Counter as cc(x_train.labels)
```

Out[36]:

```
Counter({0: 606, 1: 445, 2: 479, 3: 621, 4: 475})
```

In [37]:

```
import numpy as np
```

In [38]:

```
import tensorflow
```

In [39]:

```
from tensorflow.keras.models import Sequential
```

In [40]:

```
from tensorflow.keras import layers
```

In [41]:

```
from tensorflow.keras.layers import Dense,Flatten
```

In [42]:

```
from tensorflow.keras.layers import Conv2D,MaxPooling2D,Dropout
```

In [43]:

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

In [44]:

```
model=Sequential()
```

In [45]:

```
classifier=Sequential()
```

In [46]:

```
classifier.add(Conv2D(32, (3, 3), input_shape=(64, 64 ,3), activation='relu'))
```

In [47]:

```
classifier.add(MaxPooling2D(pool_size=(2, 2)))
```

In [48]:

```
classifier.add(Conv2D(32, (3, 3), activation='relu'))
```

In [ ]:

In [49]:

```
classifier.add(Flatten())
```

In [50]:

```
classifier.add(Dense(units=128, activation='relu'))
```

In [51]:

```
classifier.add(Dense(units=5, activation='softmax'))
```

In [52]:

```
classifier.summary()
```

```
Model: "sequential_3"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_2 (Conv2D)            (None, 62, 62, 32)        896

max_pooling2d_1 (MaxPooling  (None, 31, 31, 32)        0
2D)

conv2d_3 (Conv2D)            (None, 29, 29, 32)        9248

flatten_1 (Flatten)          (None, 26912)             0

dense_2 (Dense)              (None, 128)               3444864

dense_3 (Dense)              (None, 5)                 645

=================================================================
Total params: 3,455,653
```

Trainable params: 3,455,653
Non-trainable params: 0

In [54]:

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

In [55]:

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

In [56]:

```
from tensorflow.keras.models import load_model
```

In [58]:

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

In [1]:

```
from flask import Flask,render_template,request
```

In [2]:

```
import os
```

In [3]:

```
import numpy as np
```

In [4]:

```
from tensorflow.keras.models import load_model
```

In [5]:

```
from tensorflow.keras.preprocessing import image
```

In [6]:

```
import requests
```

In [7]:

```
app= Flask(__name__,template_folder="templates")
```

In [8]:

```
model=load_model('nutrition.h5')
```

In [9]:

```
print("Loaded model from disk")
```

Loaded model from disk

In [11]:

```
@app.route('/')def home():
    return render_template('homepage.html')
```

In [12]:

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

In [14]:

```
@app.route('/predict',methods=['GET','POST'])def launch():
    if request.method=='POST':
        f=request.files['file']
        basepath=os.path.dirname('__file__')
        filepath=os.path.join(basepath,"uploads",f.filename)
        f.save(filepath)

        img=image.load_img(filepath,target_size=(64,64))
        x=image.img_to_array(img)
        x=np.expand_dims(x,axis=0)

        pred=np.argmax(model.predict(x), axis=1)
        print("prediction",pred)
        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))
```

In [15]:

```
def nutrition(index):
    url = "https://calorieninjas.p.rapidapi.com/v1/nutrition"
    querystring = {"query":index}
    headers = {
        'X-RapidAPI-Key': 'daaf576556msh5fcbc747e5cb27cp14bd10jsn07d05ab509ae',
    'X-RapidAPI-Host': 'calorieninjas.p.rapidapi.com'
    }
    response = requests.request("GET",url,headers=headers, params=querystring)
    print(response.text)
    return response.json()['items']
```

In [ ]:

```
if __name__ == "__main__":
    app.run(debug=False)
```

CHAPTER 8

TESTING

Test case	ID Feature Type	Component	Test Scenario	Expected Result	Actual Result	Status
CT_001	*Code testing*	*Jupyter notebook*	*Code test initial run*	*Run the imported libraries and initialize the code properly*	*Verified*	*PASS*
CT_002	*Code testing*	*Registering the cloud*	*Create cloud and new asset creation*	*New asset created*	*Verified*	*PASS*
CT_003	*Data set loading*	*Load the data set in the cloud by specifying the directory*	*Dataset load*	*Loading the data set*	*Verified*	*PASS*
MT_001	*Model training*	*Image upload*	*Image upload and classify*	*Loading the image and classify*	*Verified*	*PASS*
MT_002	*Model training*	*Image classification*	*Checks and classifies the image loaded*	*Classification*	*Verified*	*PASS*
MT_003	*Model training*	*Image classification*	*Checks and classifies the image loaded*	*Classification*	*Verified*	*PASS*
MT_004	*Model training*	*Image classification*	*Checks and classifies the image loaded*	*Classification*	*Verified*	*PASS*

CHAPTER 9

ADVANTAGES:

1. Providing a food intake analysis
2. Setting nutrition goals
3. Providing educational reports
4. Managing patient or client weight changes
5. Creating diet records
6. Easy, do-it-yourself nutrition labeling
7. Recipe and formula creation
8. Quick creation and editing of food labels
9. An extensive ingredient database
10. Nutrition food label compliance
11. Food label imports from many different countries and regions
12. Diet analysis and tracking
13. Meal planning and menu creation
14. Multiple reporting styles

DISADVANTAGES:

1. Need to train many data sets

Sometimes images cannot be classified as expected

2. More technical skills required
3. AI ,ML concepts working must be understood prior.

CHAPTER 10

FUTURE SCOPE:

By this project we can integrate it with smart devices for the real time data of the nutrition when scanned ,we can either direct the data with cloud service such as AWS kinesis and do all the processing in the cloud.

We can convert the application into a mobile app so that it is easily accessible for android and ios users along with nutrition details we can also add the health benefits for fruits and vegitables which are scanned .

CHAPTER 11

CONCLUSION:

Artificial intelligence (AI) is a rapidly evolving area that offers unparalleled opportunities of progress and applications in many healthcare fields. In this review, we provide an overview of the main and latest applications of AI in nutrition research and identify gaps to address to potentialize this emerging field. AI algorithms may help better understand and predict the complex and non-linear interactions between nutrition-related data and health outcomes, particularly when large amounts of data need to be structured and integrated, such as in metabolomics. AI-based approaches, including image recognition, may also improve dietary assessment by maximizing efficiency and addressing systematic and random errors associated with self-reported measurements of dietary intakes. Finally, AI applications can extract, structure and analyze large amounts of data from social media platforms to better understand dietary behaviours and perceptions among the population. In summary, AI-based approaches will likely improve and advance nutrition research as well as help explore new applications. However, further research is needed to identify areas where AI does deliver added value compared with traditional approaches, and other areas where AI is simply not likely to advance the field. Technology is all about updates and we hope our idea will make some vital changes and receive positive reponse thank you

CHAPTER 12

PROJECT DEMO LINK :

https://youtu.be/nmV3hmFHvHI

PROJECT FILES :

https://github.com/IBM-EPBL/IBM-Project-6758-1658836312