

**AI-powered Nutrition Analyzer for Fitness Enthusiasts**  
**Professional Readiness for Innovation, Employability and Entrepreneurship**

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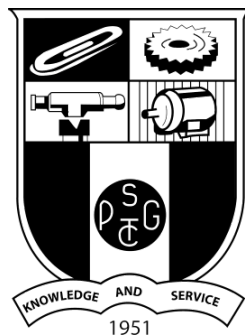
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# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 Problem Overview**

The main aim of the project is to build a model which is used for classifying the fruit depending on the different characteristics like colour, shape, texture etc. Here the user can capture the images of different fruits and then the image will be sent to the trained model. The model analyzes the image and detects the nutrition based on the fruits like (Sugar, Fibre, Protein, Calories, etc.).

### **1.2 Purpose**

Food is essential for human survival and has been the focus of many medical conventions. New dietary assessment and nutrition analysis tools now provide more opportunities to assist people in understanding their daily eating habits, exploring nutrition patterns, and maintaining a healthy diet. The process of determining the nutritional content of food is known as nutritional analysis. It is an important component of analytical chemistry because it provides information about the chemical composition, processing, quality control, and contamination of food.

# CHAPTER 2

## LITERATURE SURVEY

### 2.1 Existing Problem

This section deals with the existing work that helped provide a basis to the work and helped develop the project. Below mentioned are some of the papers that were studied before proposing a system.

### 2.2 References

S.No	Author	Title	Objective
1.	Praveen Chopra et al. (2022)	ProgressiveSpinalNet architecture for FC layers	In this paper the ProgressiveSpinalNet progressive computational network for FC layers of deep-networks is introduced as an upgraded version of the DNN concept.
2.	H M Dipu Kabir et al. (2022)	SpinalNet: Deep Neural Network with Gradual Input [2]	In this research, the SpinalNet DNN model was introduced. The chordate nervous system, which has a special way of connecting a lot of sensing data and making local decisions, is mimicked in the construction of SpinalNet.

3.	Mirra K B	Classification of Fruits Using Deep Learning Algorithms [3]	In this study a deep learning-based system for classifying fruits is suggested. A DCNN model, an AlexNet model, and a MobileNetV2 model were investigated in the proposed framework. Three datasets with different sizes and levels of complexity were used to test the recommended framework.
4.	Feras Albardi et al (2021)	A Comprehensive Study on Torchvision Pre-trained Models for Fine-grained Inter-species Classification	This study attempts to investigate various pre-trained models provided in the PyTorch library's Torchvision package. And look into how well they can classify fine-grained photos.

5.	Nguyen Vuong Thinh et al (2021)	Fruits classification by using machine learning - An experiment using popular approaches on local data	In this paper, we examine the methods for classifying images that can be used to categorize fruits. The study's findings can be used to place fruit on the correct shop shelves, spot fruit mismatches there, or check fruit prices without using a barcode scanner. Three well-known classification models—Random Forest, K-Nearest Neighbors (KNN), and Support Vector Machine—are employed in this study (SVM).
6.	Haci Bayram Ünal et al. (2021)	Fruit Recognition and Classification with Deep Learning Support on Embedded System (fruitnet)	This suggested study employs image processing techniques for fruit recognition. Convolutional Neural Networks (ConNN)* deep learning model for classification is created in the study. The Keras platform was used to construct the suggested model.
7.	Marieke van Erp et al. (2021)	Using Natural Language Processing and Artificial Intelligence to Explore the Nutrition and Sustainability of Recipes and Food	According to this paper's point of view, interdisciplinary approaches should be used to address food and recipe research in order to address health and sustainability issues. These approaches should combine NLP and other AI techniques with



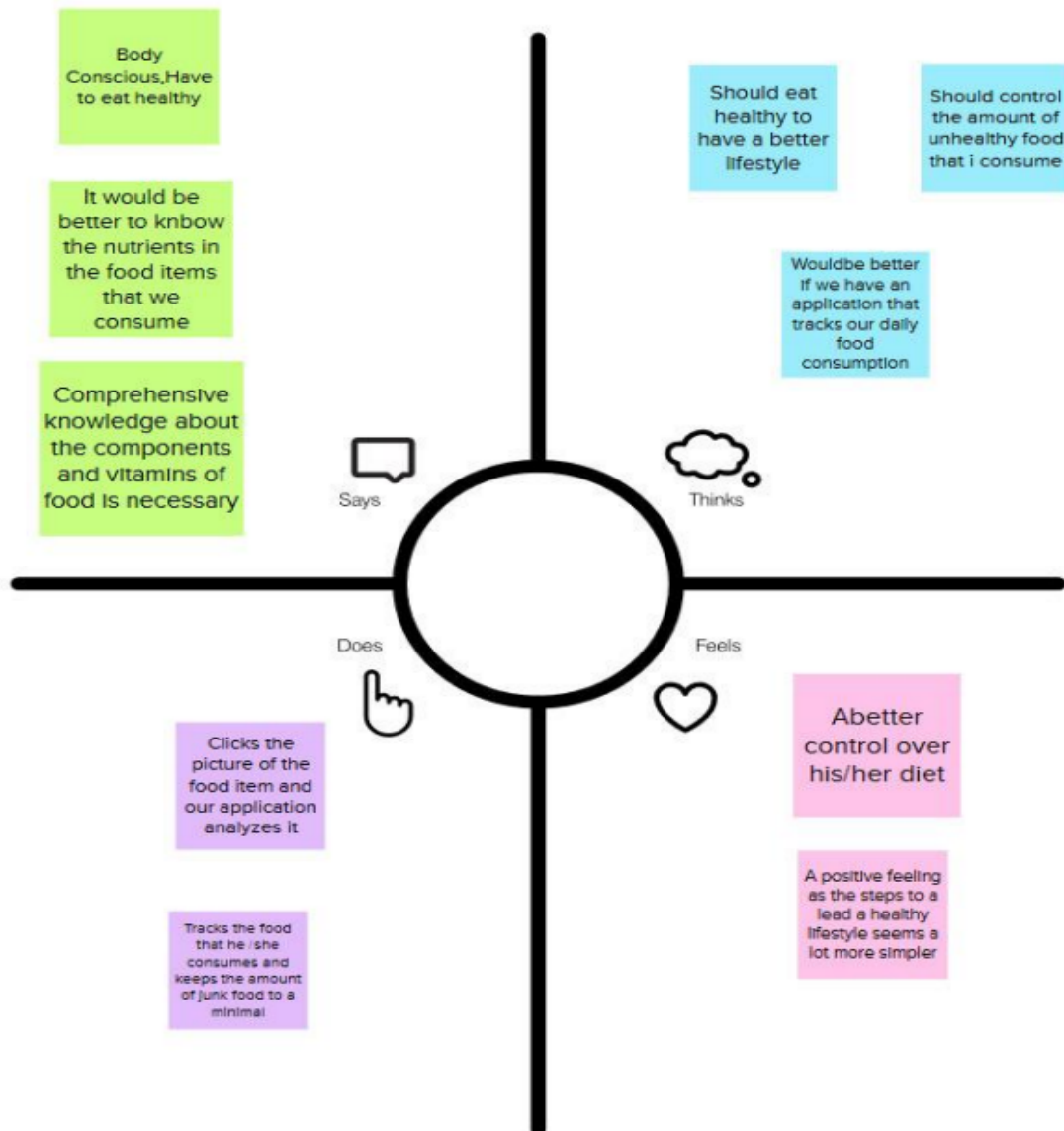
			historical food research, food science, nutrition, and sustainability expertise.
8.	Mehenag Khatun et al. (2020)	Fruits Classification using Convolutional NeuralNetwork	This study investigates a CNN-based classification of fruits. For five scenarios utilizing the fruits-360 dataset, the accuracy and loss curves were created using various combinations of hidden layers. This paper discusses several computer vision-based approaches and algorithms for fruit recognition and classification.
9.	Siyuan Lu et al. (2016)	Fruit classification by HPA-SLFN	In this study, we introduced a brand-new fruit classification method called HPA-SLFN. The findings indicated that HPA-classification SLFN's accuracy of 89.5% was superior to those of other classification techniques.

10.	Ghulam Muhammad et al. (2015)	Date fruits classification using texture descriptors and shape-size features [10]	In this study a suggested technique breaks down a visual image of a date into its component colours. The local texture descriptor, such as a Weber local descriptor (WLD) histogram or a local binary pattern (LBP), is then applied to each component in order to encode the texture pattern of the date. To characterise the image, the texture patterns from each component are combined.
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# CHAPTER 3

## IDEATION & PROPOSED SOLUTION


### 3.1 Empathy Map Canvas






## 3.2 Ideation & Brainstorming

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

Template



## Brainstorm & idea prioritization


 10 minutes to prepare  
 1 hour to collaborate  
 4 people

19I215 Gowtheam G  
19I229 Lakshana C R  
19I262 Abishavarthana P  
20I435 Raja Kumar I

1


**Define your problem statement**

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 (Sugat, Fibre, Protein, Calories, etc.).

 5 minutes







PROBLEM

AI-Powered Nutrition  
Analyzer For Fitness  
Enthusiasts



**Key rules of brainstorming**

To run an smooth and productive session

 Stay in topic.	 Encourage wild ideas.
 Defer judgment.	 Listen to others.
 Go for volume.	 If possible, be visual.

## Step-2: Brainstorm, Idea Listing and Grouping

### 2 Brainstorm

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

10 minutes

**Gowthaam G**

- A Progressive Spinal Net, progressive computational network for FC layers of deep networks can be used.
- Three datasets with different sizes and levels of complexity can be used to test the model.

**Lakshana C R**

- Based on the nutrients available in the fruits classify them.
- Three well-known classification models—Random Forest, K-Nearest Neighbors (KNN), and Support Vector Machine can be used to classify images to categorise fruits.
- Convolutional Neural Networks (ConvNN) deep learning model for classification.
- Keras platform was used to construct the suggested model.

**Abishavarthana P**

- Interdisciplinary approaches should be used to address food and recipe research in order to address health and sustainability issues.
- A technique breaks down a visual image of a date into its component colours.

**Raja Kumar I**

- Brand new fruit classification method called HFA-SLFN can be implemented for classification as it gives better results when compared to other techniques.
- The accuracy and loss curves were created using various combinations of hidden layers.
- A computer vision-based approaches and algorithms for fruit recognition and classification.

### 3 Group Ideas

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you can break it up into smaller sub-groups.

20 minutes

#### Features & Extraction

- Based on the nutrients available in the fruits classify them.
- Three datasets with different sizes and levels of complexity can be used to test the model.

#### Model

- To characterise the image, the texture patterns from each component are combined.
- The local texture descriptor, such as a Weber local descriptor (WLD) histogram or a local binary pattern (LBP), is then applied to each component in order to encode the texture pattern of the date.
- Brand-new fruit classification method called HFA-SLFN can be implemented for classification as it gives better results when compared to other techniques.
- Convolutional Neural Networks (ConvNN) deep learning model for classification.

#### Classification

- A Progressive Spinal Net, progressive computational network for FC layers of deep networks can be used.
- Keras platform was used to construct the suggested model.

#### Approach

- The accuracy and loss curves were created using various combinations of hidden layers.
- A chordate nervous system, which has a special way of connecting a lot of sensing data and making local decisions, is mimicked in the construction of SpinalNet.
- A technique breaks down a visual image of a date into its component colours.
- A computer vision-based approaches and algorithms for fruit recognition and classification.

### Step-3: Idea Prioritization



### 3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	The main aim of the project is to build a model which is used for classifying the fruit depending on the different characteristics like colour, shape, texture etc.
2.	Idea / Solution description	Brand-new fruit classification method called HPA-SLFN can be implemented for classification as it gives better results when compared to other techniques
3.	Novelty / Uniqueness	The models performance and accuracy for the analyses of image and detection rate of the nutrition based on the fruits is higher.
4.	Social Impact / Customer Satisfaction	Here the user can capture the images of different fruits and then the image will be sent to the trained model. The model analyzes the image and detects the nutrition based on the fruits like (Sugar, Fibre, Protein, Calories, etc.).
5.	Business Model (Revenue Model)	<ul style="list-style-type: none"> <li>•Data analytics</li> <li>•Statistics</li> <li>•Future prediction</li> </ul>
6.	Scalability of the Solution	The model is scalable from the architecture and dataset training perspective. We can train huge amounts of image data by converting them into .npy / .npz file format which would facilitate easy storing, retrieving and processing.

### 3.4 Problem Solution fit

Project Title: AI-Powered Nutrition Analyzer For Fitness Enthusiasts Team ID: PNT2022TMID13086    Date: 7 October 2022		Project Design Phase-I - Solution Fit Maximum Marks: 2 Marks		
Define CS, fit into CC	<b>1. CUSTOMER SEGMENT(S)</b> <span>CS</span> Who is your customer? i.e. working parents of 0-5 y.o. kids  Fitness Enthusiasts who like to lead a healthy life and well balanced diet	<b>6. CUSTOMER CONSTRAINTS</b> <span>CC</span> What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices.  <ul style="list-style-type: none"> <li>• Lack of inaccurate information about food nutrition values.</li> <li>• Only thinking about leading a healthy life without taking actions.</li> <li>• Not having a personal assistant to monitor their daily nutritional intake</li> </ul>	<b>5. AVAILABLE SOLUTIONS</b> <span>AS</span> Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros & cons do these solutions have? i.e. pen and paper is an alternative to digital notetaking  They can hire a personal Nutritionist. They can consult dietitians. They can use apps. There are many apps like My Fitness Pal, Chromometer, Life sum, etc.... which people resort to for good health.	Explore AS, differentiate
	<b>2. JOBS-TO-BE-DONE / PROBLEMS</b> <span>J&amp;P</span> Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides.  Individual physical exercise or yoga without prior knowledge may lead to muscle cramp. So can be tackled by use of animated guide videos for that.	<b>9. PROBLEM ROOT CAUSE</b> <span>RC</span> What is the real reason that this problem exists? What is the back story behind the need to do this job? i.e. customers have to do it because of the change in regulations.  Due to fast paced lifestyle, Availability of low quality and nutrition less food, Improper diet plan, Lack of health related awareness, Emotional eating, not following strict timings	<b>7. BEHAVIOUR</b> <span>BE</span> What does your customer do to address the problem and get the job done? i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace)  <ul style="list-style-type: none"> <li>• Have a regular and enough sleep</li> <li>• Have an application to track their daily nutrition values.</li> <li>• Have a perfectly balanced diet plan</li> </ul>	
Identify strong TR & EM	<b>3. TRIGGERS</b> <span>TR</span> What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.  To maintain good health and to regulate their eating and good intake of foods.  <b>4. EMOTIONS: BEFORE / AFTER</b> Before: People can't track their health details. People can't improve their health in proper Manner After: Users can maintain and can improve their Body fitness	<b>10. YOUR SOLUTION</b> <span>SL</span> If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.  Creating a web application for users to track, monitor and maintain their health by performing specialized suggestions for each and every user.	<b>8. CHANNELS of BEHAVIOUR</b> <span>CH</span> <b>8.1 ONLINE</b> What kind of actions do customers take online? Extract online channels from #7  ONLINE: Taking advice from the nutrition expert and following fitness based online apps.  OFFLINE: Working out regularly, and maintaining the regular activities as per the prescribed schedule	Extract online & offline CH of BE



# CHAPTER 4

## REQUIREMENT ANALYSIS

### 4.1 Functional requirement

#### 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	<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. In the web interface,</p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> </ul>
FR-2	User Management	<p>Creating a group of people, who are willing to be fit in their health and making them organized in a same place, through which they can collaborate and also can achieve their goals with others, by encouraging each other. The application gives the ability to ask questions about a problem in the fitness groups, through which they can work effectively.</p>
FR-3	User Satisfying	<p>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</p>
FR-4	User Engagement	<p>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.</p>

## 4.2 Non-Functional requirements

### Non-functional Requirements:

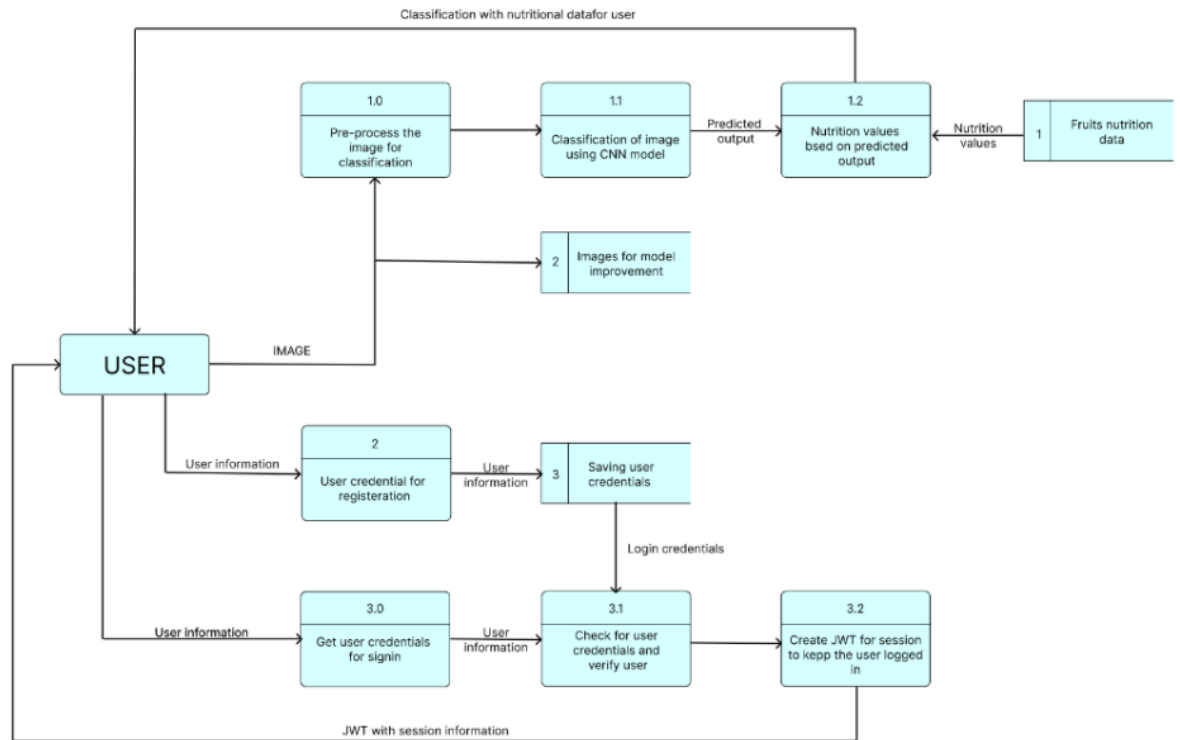
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	<b>Usability</b>	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	<b>Security</b>	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	<b>Reliability</b>	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	<b>Performance</b>	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 (DataStructures and Algorithms)
NFR-5	<b>Availability</b>	Even though it is a good application for registered users, it has the ability to offer minimum functionality to the non-registered users and also to increase the audience base.
NFR-6	<b>Scalability</b>	The application should be as much as scalable, in order to increase the number of users based on their interest.

# CHAPTER 5

## PROJECT DESIGN

### 5.1 Data Flow Diagrams



### 5.2 Solution & Technical Architecture

Solution:

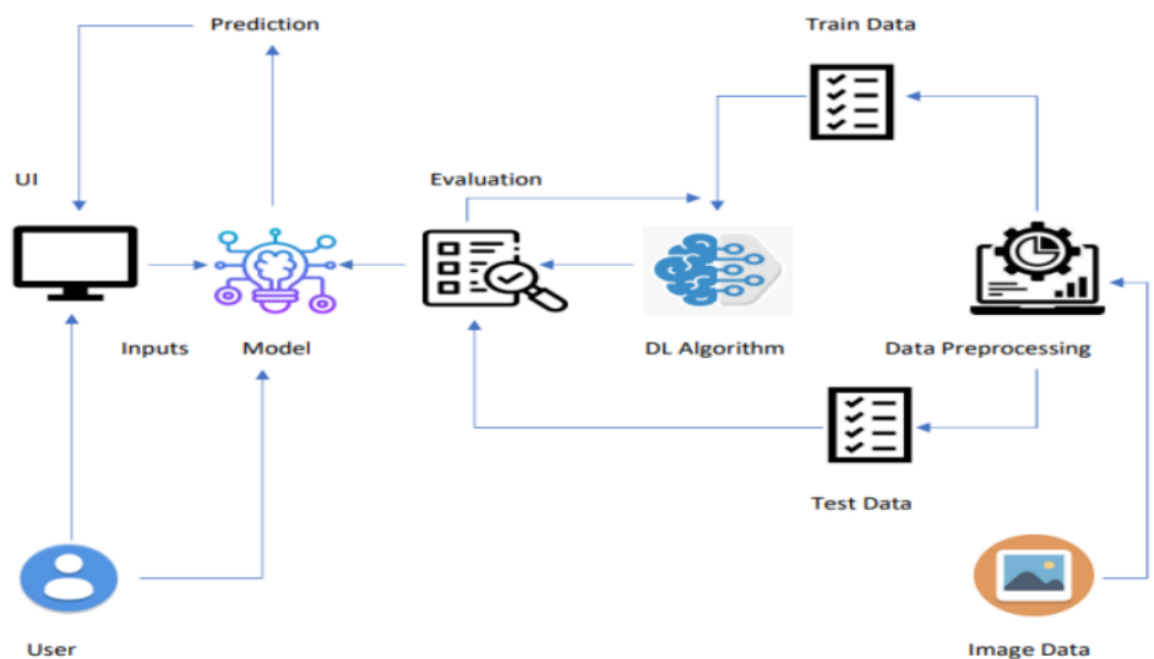
Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	. Application	User interacts with application for the prediction of Nutrition	Python, Java, HTML,SQL,Android studio,JavaScript,ReactJS,tailwindCSS
2.	Database	Data Type, Configurations and data will be stored	MySQL, JavaScript
3.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudland, etc
4.	File Storage	File storage requirements	The storage will be based on Cloud
5.	Machine Learning	Purpose of Machine Learning Model	ANN, CNN, RNN
6.	Notification	Notification will be sent from the server	SendGrid.
7.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
8.	External API	Purpose of External API used in the application	Aadhar API, Stripe
9.	Machine Learning Model	Purpose of Machine Learning Model	OpenCV, MATLAB.
10.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration :	Local, Cloud Foundry, Kubernetes, etc.

**Table-2: 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 predictions per second	IBM Load Balance

### Technical Architecture:



## 5.3 User Stories

Use the below template to list all the user stories for the product.

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	I can access the Dashboard with Microsoft.	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password	I can login the Application by entering password	High	Sprint-1
	Main Interface	USN-6	As a user I can view my calorie intake by clicking photo of the food I eat	Access the proper information about the nutrition and the calorie intake	High	Sprint-2
	Package DB, Dashboard	USN-7	As a user I can choose variety of packages based on my requirement	Selecting an appropriate package	Medium	Sprint-2
Customer Care Executive	Feedbacks DB , Toll Free number, chat bot	USN-8	As a customer care executive, I collect feedbacks from customers	Maintaining proper environment for the customers	High	Sprint-2
Dietitian	Customer Record	USN-9	As a dietitian I provide daily plans for the betterment of the user	Positive results from user	High	Sprint-2
Administrator	Dashboard	USN-10	As an administrator I take care of all the operations which takes place in the app	Zero issues from the user	High	Sprint-2

# CHAPTER 6

## PROJECT PLANNING & SCHEDULING

### 6.1 Sprint Planning & Estimation

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (ason 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

### 6.2 Sprint Delivery Schedule

Sprint	Function al Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Login method	USN-1	As a user, I can find the login method more efficient	7	High	Gowthaam, Raja Kumar
Sprint-2	Device interface	USN-2	As a user, I can use it with minimal physical interaction with the device.	6	Medium	Lakshana, Abishavart hana, Gowthaam
Sprint-4	features	USN-3	As a user, I can find Many features available	10	Low	Raja Kumar, Gowthaam, Lakshana
Sprint-3	Safety	USN-4	As a user, I need to get the Nutritional data which are accurate and safe	5	High	Gowthaam, Abishavarth ana
Sprint-1	Testing	USN-5	As a	7	Medium	Gowthaam,

			developer, we must ensure the app is working properly for the users			Lakshana
Sprint-3	Correction	USN-6	To correct any bugs/Failure reported	6	High	Abishavarthan, Gowthaam , Lakshana
Sprint-1	Results	USN-7	As a user, I can rely on the results without any suspicion	6	High	Lakshana
Sprint-3	Uses	USN-8	As a user, I can benefit from the result as it will help me maintain a proper diet	8	Medium	Raja Kumar, Abishavarthana
Sprint-2	Speed	USN-9	As a user, I can get the results on the spot immediately after the screening process.	7	Low	Lakshana, Abishavarth and Gowthaam
Sprint-4	Suggestions	USN-10	As a user, I should be able to get suggestions according to my body type	10	Medium	Abishavarthan, Gowthaam, Raja Kumar
Sprint-3	Cost-effectiveness	USN-11	As a user, I can reach many people who are too occupied with their work to get a proper workout and need to maintain a	4	Medium	Raja Kumar, Lakshana, Gowthaam

			proper diet			
Sprint-2	Informati ve	USN-1 2	As a user, I can create awareness among the people to have a healthy diet habit for a healthy body	7	Low	Abishavarth an, Lakshana



# CHAPTER 7

## CODING

### 7.1 Feature 1 :

The registration page of the application is designed. If the user has not registered already then user registration is carried out. Sufficient efforts were taken in to make this process seamless. Now the user can login in directly if he has signed up. The parameters taken for registration were Email id,name and password. This data is stored in firebase and the code for its connection with the backend was successful.

### 7.2 Feature 2 :

The image can be uploaded and the trained machine learning model is able to predict the output and the nutrition values are also displayed in the same page. the accuracy of the model came out to be 95% and when it was trained on IBM cloud it amounted to 100%.

### 7.3 Database Schema :

Firebase was implemented.The Firebase database (NoSQL) provides a mechanism for storage and retrieval of data which is modeled in means other than the tabular relations used in relational databases.

# CHAPTER 8

## TESTING

### 8.1 Test Cases

The test cases taken were pertinent to registration and uploading images.

Failure Cases : Email : 123,hjf (not a valid email)

Verdict : Test Case failed (Please enter valid email address)

The above test cases were extended for various emails and the process gave a 100% positive result.

With regards to the image part a text file was uploaded as a corner case and the error message was generated and displayed

### 8.2 User Acceptance :

10 people used the sample application and they were able to find the nutrient information of the fruit picture they uploaded.

### 8.3 : Integration Testing :

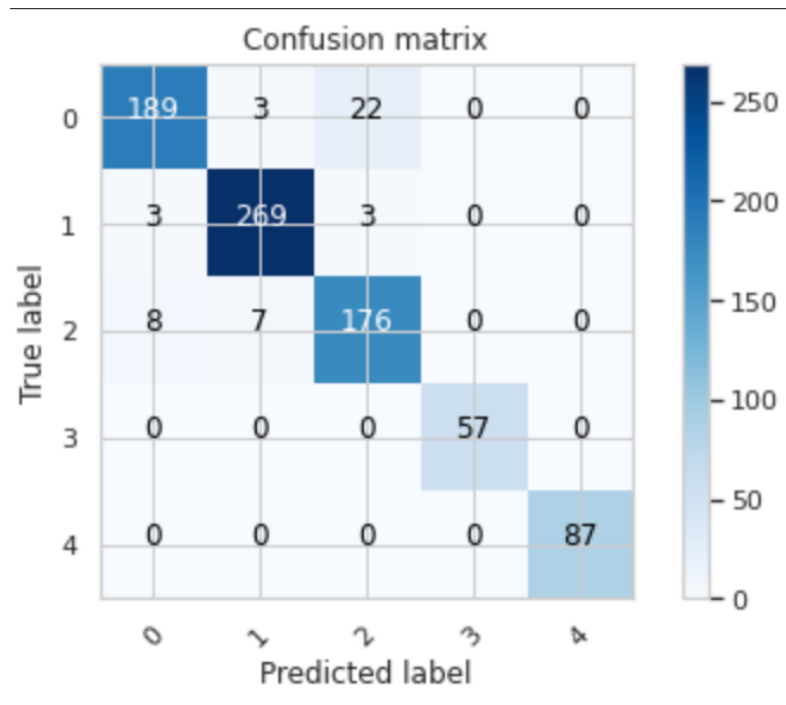
In this both the registration modules and the prediction modules were combined and tested which proved to give proper results.

# CHAPTER 9

## RESULTS

### 9.1 Performance Metrics

The results of the machine learning algorithm came up to be 95%. The confusion matrix is shown below.



# **CHAPTER 10**

## **ADVANTAGES & DISADVANTAGES**

Nutrition facts labels are crucial whether it is needed for own product or are proactive in what is eaten. Nothing can be left to chance when it comes to receiving and sharing all relevant nutrition information. Accurate label information is paramount if one is on a special diet or has food allergies. This detailed nutrition information helps to ensure proper eating habits. Nutrition facts labels are critical for people looking to improve their health. This article addresses the reasons why labels are essential tools that provide transparency to today's consumers. One can achieve the following by learning the nutrition facts about the fruits they consume,

- Helps one eat consciously
- Keeps skin, teeth, and eyes healthy
- Supports muscles
- Boosts immunity
- Strengthens bones

The limitations of the application are that it only works for 5 fruits and there are a lot of other foods that need to be classified and sufficient information about the fruits should also be displayed. This would ameliorate the use of the application and would help more users to eat in a healthier way.

# **CHAPTER 11**

## **CONCLUSION**

Thus the application to classify 5 different fruits was created and it was implemented successfully. the accuracy came out to be 95% and registration pages to onboard users were also created.

## **CHAPTER 9**

### **FUTURE WORK**

The scope of the project could be extended to classify various other food items and give nutritional information about the same. Calorie trackers could be implemented to give users more insights about their eating habits. A healthy meal schedule could be recommended once sufficient information has been gathered.

# CHAPTER 13

## APPENDIX

### GitHub & Project Demo Link

Github:

<https://github.com/IBM-EPBL/IBM-Project-13067-1659509356>

Demo Link :

[https://drive.google.com/file/d/1yR\\_Yt-VCQw8jNeBvpqvN4cKluxmguPQP/view?usp=sharing](https://drive.google.com/file/d/1yR_Yt-VCQw8jNeBvpqvN4cKluxmguPQP/view?usp=sharing)

# CHAPTER 14

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