AI Powered Nutrition Analyzer for Fitness Enthusiasts

Project report

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INTRODUCTION

1.1 Project Overview

Nutrition analyzer aims to use personal information about individuals or groups of individuals to deliver nutritional advice that, theoretically, would be more suitable than generic advice. Nutritional analysis is the process of determining the nutritional content of food. Deep learning, a sub branch of Artificial Intelligence, has promised to aid in the development of predictive models that are suitable for analyzing Nutrition. Using the prediction made by CNN to provide nutrition values of the food or fruits, that help fitness enthusiasts to track their daily nutrition intake to maintain a healthy life.

1.1 Purpose

The main problem faced by fitness enthusiasts is tracking their daily nutrition intake which is important to stay fit. But in today's bustling society and availability of abundant resources online about fitness, tracking nutrition will become more challenging and inaccurate. Fitness enthusiasts normally follow their diet plans but they struggle tracking nutritional contents of the food. Fruits are rich in vitamins, fibers, and minerals which makes them easily digestible, but over-consumption will result in weight gain and even diabetes as fruit contains natural sugar. The purpose of the project is to provide web application to monitor and track their health condition and help the people to improve their health condition.

LITERATURE SURVEY

1.3 Existing problem

In today's bustling society and availability of abundant resources online about fitness, tracking nutrition will become more challenging and inaccurate. There are a lot of misconceptions among people about fitness, and the lack of awareness about the nutritional values of food.

1.4 References

1. To recognize multiple fruits more accurately, the authors (**Pure-CNN: A Framework for Fruit Images Classification**) proposed a Pure Convolutional Neural Network (PCNN) with minimum number of parameters. The PCNN consists of 7 convolutional layers.

   Additionally, to reduce overfitting and taking average of whole feature maps we employed recently developed Global Average Pooling (GAP) layer that is verified to be very effective. They analysed classification performance using PCNN on recently introduced fruit-360 dataset. The experimental results of the 55244 color fruit images from the 81 categories, show that the PCNN achieved a classification accuracy of 98.88%. The paper presents a new approach to improve fruit image classification using PCNN with Global Average Pooling (GAP). The highest classification accuracy of 98.88% was obtained when using PCNN with GAP layer. Thus this method can be used for both object recognition and multi-class image classification.

2. In paper (**Fruit Classification using Convolutional Neural Network via Adjust Parameter and Data Enhancement**) the author proposed a method of fruit automatic recognition and classification based on CNN. The paper used 2 data sets , one is a two color fruit image data set (a public data set and the other is a self-made data set).

The methods used are preprocessing and Classification Network.

They used deep learning module in halcon software. They used the pretraining network built in halcon software to classify and identify fruit images. The CNN used in this paper does not give specific network structure.

According to the experimental results, the method proposed in this paper provides an effective method for automatic recognition and classification of fruit images.

After parameter adjustment, and achieved the highest average classification accuracy of 99.8% on the public data set. In the self-made data set, the classification accuracy is 90.2%.

3. **Improving the Prediction of Rotten Fruit Using Convolutional Neural Network**. This research developed two models for fruit recognition and predicting the freshness or spoilage of fruit using the CNN approach based on VGG16 architecture.

The first model was developed from the RGB images dataset, while the second model has developed from the concatenated images dataset, including RGB

image, LoG image, grayscale without background image, and HSV with AGT image.

This model gave the validation accuracy of 89.97% and the validation loss of 4.98% during the validation processing.

4. **DeepFood: Food Image Analysis and Dietary Assessment via Deep Model by LANDU JIANG1,2 , BOJIA QIU2, XUE LIU2, CHENXI HUANG1, AND KUNHUI LIN1 on 2016**. The model developed had a three-step algorithm to recognise food and then to create a dietary plan using the dataset available. They used the fat, calories, carbohydrate and proteins as its primary factor to create a dietary plan, which was obtained from the model which can identify the food details. They used Convolutional Neural Network (CNN), Region Proposal Network (RPN).

Dataset used by them were UEC-FOOD100, UEC-FOOD256.

5. **Personalized Classifier for Food Image Recognition by Shota Horiguchi, Sosuke Amano, Makoto Ogawa, and Kiyoharu Aizawa in 2015**. They used a method of incremental learning to get output more personalized to the end user, to increase the accuracy. So each user had a personalized prediction from a personalised model which was trained dynamically with the sample input dataset obtained from them by using

a food logging application. They used Convolutional Neural Network (CNN).

6. **Very deep convolutional networks for large-scale image recognition**. In this paper, Author proposed about investigating the effect of the convolution network depth with enormous accuracy . their main contribution is that increasing cn depth using convolution filter (3X3) architecture. That can be achieved by pushing the depth to 16–19 weight layer . the Basics of our ImageNet challenge 2014 submission where their team secure first place In training of convNet configuration , their input to convNETs is fixed size 224x224 rgb image (converted as square image) that multiplied by 3x3 convoluTion matrix

In this work ,they evaluated CNN for large scale image classification. It is beneficial for the classification accuracy. They showed that their model generalized well to a wide range of tasks and datasets matching or outperforming more complex recognition pipelines built around less deep image representations. Their results yet again confirm the importance of depth CNN.

7. **Dropout: A Simple Way to Prevent Neural Network from Overfitting**, the authors proposed a method called Dropout, a simple way to prevent overfitting in neural networks. The key idea is to randomly drop units

along with their connections from the neural network during training. This prevents units from co-adapting too much.

The central idea behind the method is to take a large model that overfits easily and repeatedly sample nad train smaller sub-models from it. They implemented this method to variety of application domains including object classification, digit recognition, speech recognition and more and resulted in reducing the error and improves the models performance.

The major drawback of this method is that is increases training time. A dropout network typically takes 2-3 times longer to train than a standard neural network of the same architecture.

1.5 Problem statement definition

The main problem faced by fitness enthusiasts is tracking their daily nutrition intake which is important to stay fit. But in today's bustling society and availability of abundant resources online about fitness, tracking nutrition will become more challenging and inaccurate. Fitness enthusiasts normally follow their diet plans but they struggle tracking nutritional contents of the food. Fruits are rich in vitamins, fibers, and minerals which makes them easily digestible, but over-consumption will result in weight gain and even diabetes as fruit contains natural sugar.

Fitness enthusiasts follow a diet which contains fruits, vegetables, protein rich foods and low carb foods. But tracking their nutritional contents like fiber, protein and essential nutritions will not be an easy task.

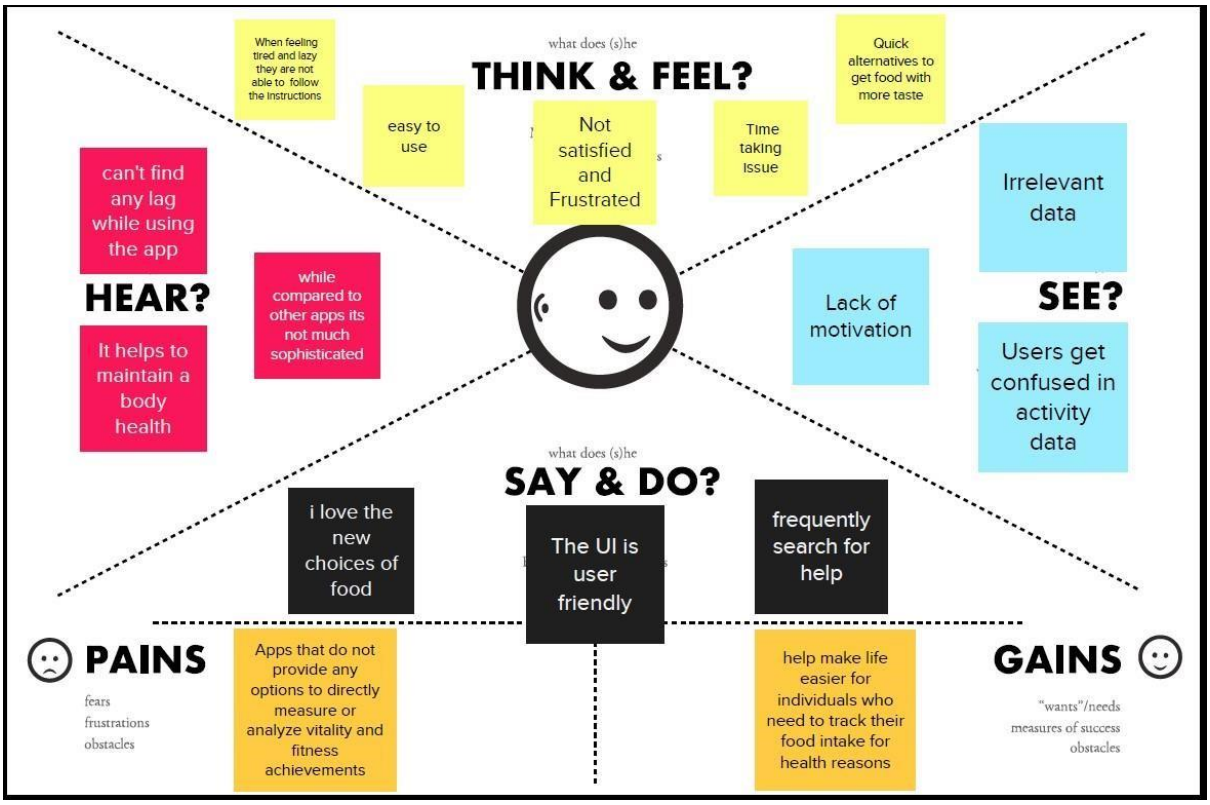
Some fruits are allergic to some consumers based on their medical condition. Which they need to identify before consuming.

Identifying nutritional values of unknown food and fruit varieties will become impossible without online technologies as they have no prior knowledge about them.

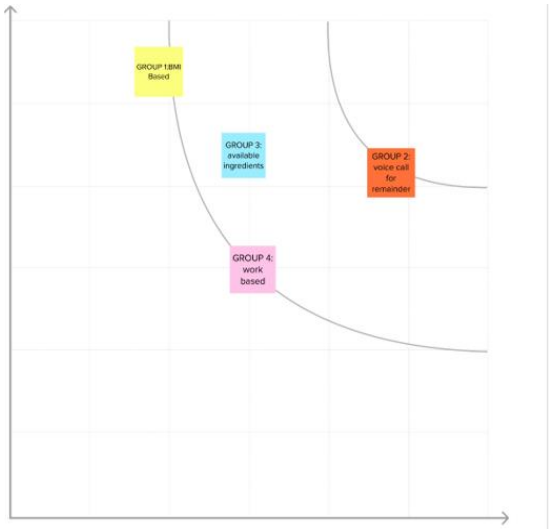
IDEATION & PROPOSED SOLUTION

1.6 Empathy Map Canvas

EMPATHY MAP FOR FITNESS ENTHUSIASTS



1.7 Ideation & Brainstorming



1.8 Proposed solution

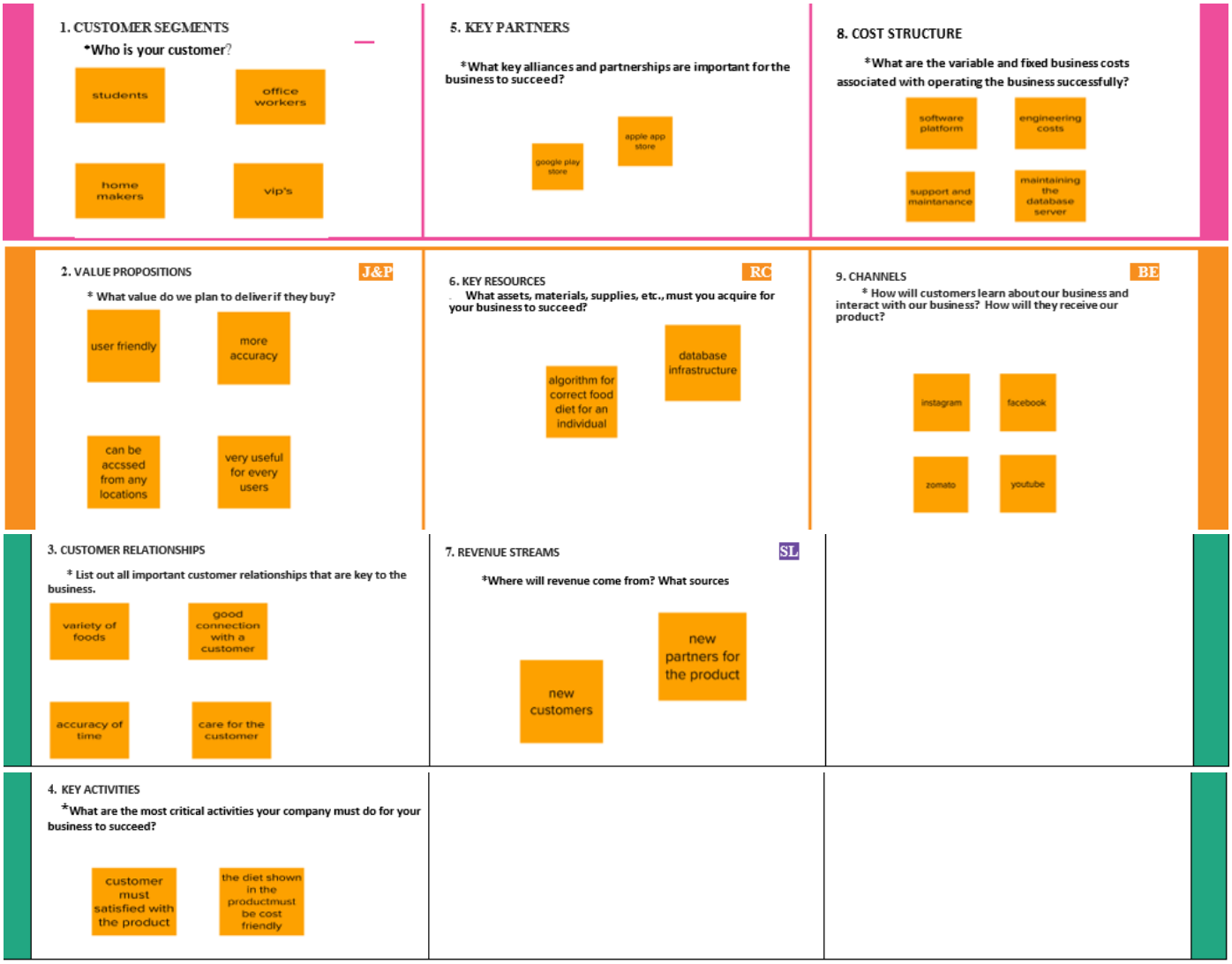
Creating web interface application to monitor and track their health condition and helping people to improve their health.

Uniqueness of the solution : CNN based fruit classifier that supports nutrition analyser that provides nutrition values of the fruit.

Social Impact / Customer Satisfaction : By improving the health people can concentrate on their daily duties and work.

Scalability of the Solution : For now the nutrition analyser is limited to mostly fruits only, which can be scaled to other foods. Implementing in mobile app.

1.9 Problem Solution fit



REQUIREMENT ANALYSIS

1.10 Functional requirements *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.
- 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.

User Management :

Creating a group of people, who are willing to benefit in their health and making them organized in the 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.

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.

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.

1.11 Non-Functional Requirement

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.

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 .

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

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 (DataStructures and Algorithms).

Availability :

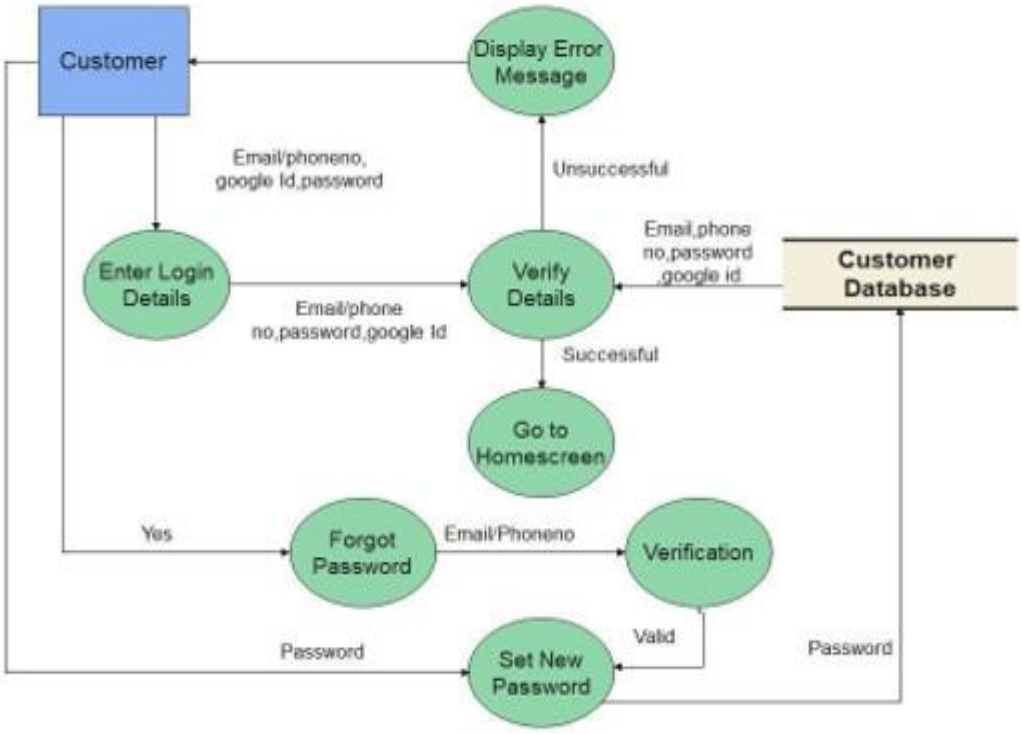
Even though it is a good application for registered users, it has the ability to offer minimum functionality to the non-registered users and also to increase the audience base.

Scalability :

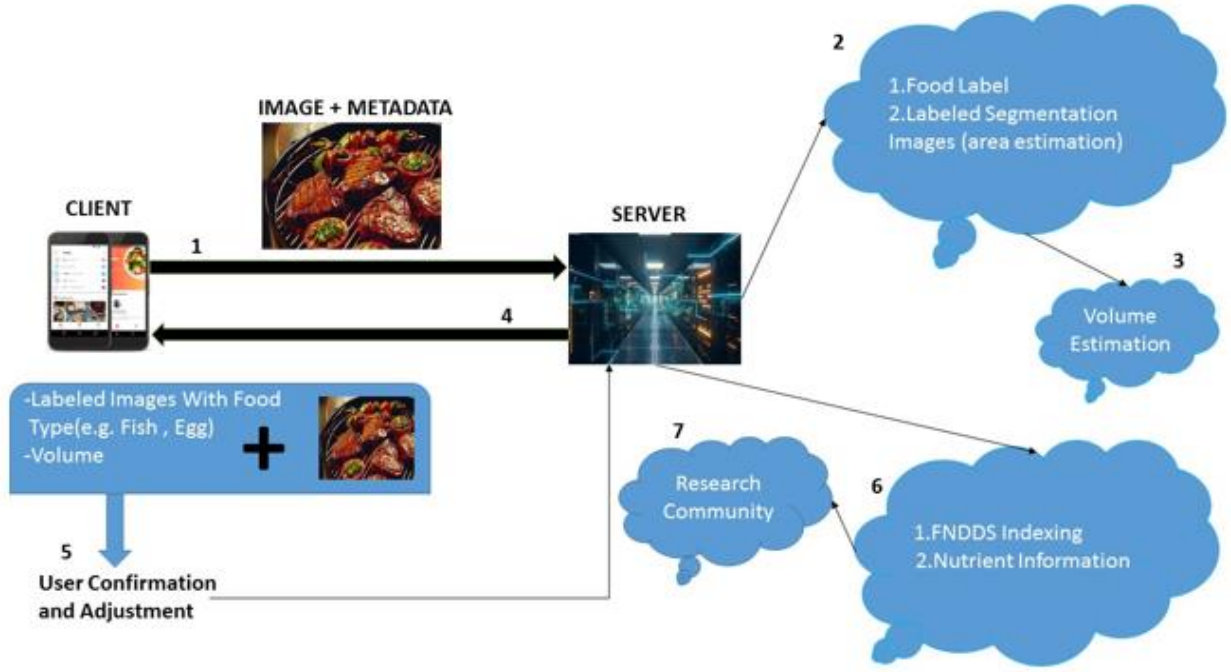
The application should be as much as scalable, in order to increase the number of users based on their interest.

PROJECT DESIGN

1.12 Data Flow Diagrams



1.13 Solution & Technical Architecture



1.14 User Stories

1. As a user, I can register for the application by entering a unique user id, password, and confirming my password.
2. Home page, About page. Navigate through the application easily (easy user experience and interface).
3. As a user, I can upload pictures from the camera and also from the device.
4. As a user, I can access the application without signing in.
5. As a user, I can logout from the application.
6. As a user, I can access information (nutritional Content) about other fruits also in the application.
7. As a user, I get daily motivational quotes.

8. As a user, I can get suggestion of fruits based on season and health condition.
9. As a user, I can monitor my daily water intake as per my body weight, and get periodic reminders.
10. As a User I can View the issues and reports done by common users and the administrator.
11. As a User I can give Feedback.
12. As a User I can update and view my BMI
13. As a administrator I need to confirm that the users data are in secure format.

PROJECT PLANNING & SCHEDULING

1.15 Sprint Planning & Estimation

Sprint 1

1. Registration and login
2. Main page, About Page
3. Logout

Sprint 2

1. Prediction
2. Anonymous Usage
3. Searching fruits data manually
4. Motivational quotes suggestion
5. Searching
6. Dashboard
7. Report page

Sprint 3

1. Monitoring
2. Health details management
3. Dashboard
4. Feedback page
5. BMI update page
6. Storing Data

Sprint 4

Security check

1.16 Sprint Delivery Schedule

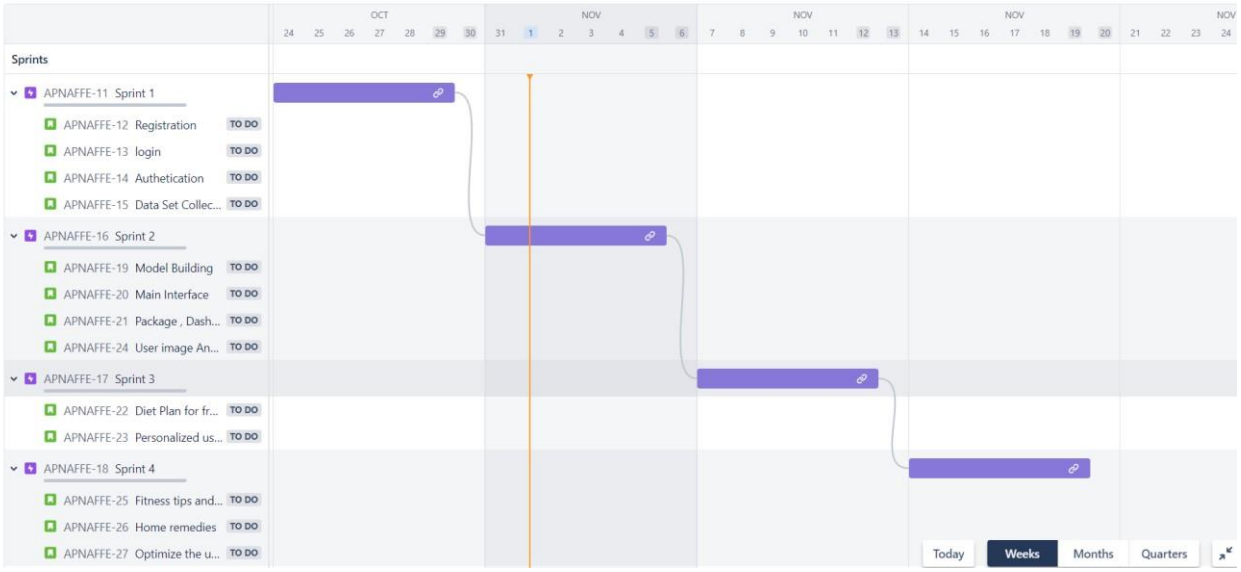
Sprint 1 - 29/10/2022

Sprint 2 - 05/11/2022

Sprint 3 - 12/11/2022

Sprint 4- 18/11/2022

1.17 Reports from JIRA



CODING & SOLUTIONING

Features

- Registration
- Login
- Logout
- Search Fruits
- Fruit classifier ● Fruit details
- Calorie details
- Search quote
- BMI
- Feedback
- Report

Source codes for the features are in our Git repository.

TESTING

Test cases

				Date	17-Nov-22							
				Team ID	PNT2022TMID27756							
				Project Name	Project - AI-powered Nutrition Analyzer for Fitness Enthusiasts							
				Maximum Marks	4 marks							
case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Commnets	TC for Automation(Y/N)	BUG ID	Executed By
HomePage_TC_OO1	Functional	Home Page	Verify user is able to see the Login/Signup.		1.Enter URL and click go 2.Click on sigin/signup navbar button 3.Verify login/Singup displayed or not	Website link	Login/Signup popup should display	Working as expected	Pass	NIL	N	-	Banuchandran , Bhuvaneshwaran , Karthick, Karthikeyan
HomePage_TC_OO2	UI	Home Page	Verify the UI elements in Login/Signup buttons		1.Enter URL and click go 2.Click on signin navbar button 3.Verify login/Singup popup with below UI elements: a.user text box b.password text box c.Login button d.New customer? Signup	Website link	Application should show below UI elements: a.Username text box b.password text box c.Login button with orange colour d.New customer? Create account link	Working as expected	Pass	NIL	N	-	Banuchandran , Bhuvaneshwaran , Karthick, Karthikeyan
HomePage_TC_OO3	Functional	Home page	Verify user is able to log into application with Valid credentials		1.Enter URL and click go 2.Click on signin navbar button 3.Enter Valid username text box 4.Enter valid password in password text box 5.Click on login button	Username: test1 password: Test123	User should navigate to user account homepage	Working as expected	Pass	NIL	N	-	Banuchandran , Bhuvaneshwaran , Karthick, Karthikeyan
HomePage_TC_OO4	Functional	Home page	Verify user is able to log into application with InValid credentials		1.Enter URL and click go 2.Click on Signin navbar button 3.Enter InValid username text box 4.Enter valid password in password text box 5.Click on login button	Username: test2 password: Test12	Application should show 'Incorrect email or password ' validation message.	Working as expected	Pass	NIL	N	-	Banuchandran , Bhuvaneshwaran , Karthick, Karthikeyan
HomePage_TC_OO5	Functional	Home page	Verify user is able to log into application with InValid credentials		1.Enter URL(https://shopenzer.com/) and click go 2.Click on My Account dropdown button 3.Enter Valid username/email in Email text box 4.Enter Invalid password in password text box 5.Click on login button	Username: chalam@gmail.com password: Testing1231678686786876876	Application should show 'Incorrect email or password ' validation message.	Working as expected	Pass	NIL	N	-	Banuchandran , Bhuvaneshwaran , Karthick, Karthikeyan
HomePage_TC_OO6	Functional - Upload photo	Home page	Verify user is able to upload the photo from device		Choose the image and click go	Uploaded image	Application should upload the image to server.	Working as expected	Pass	NIL	N	-	Banuchandran , Bhuvaneshwaran , Karthick, Karthikeyan
ge_TC_OO7	UI	About page	Verify user is able to see the about page content.		Scroll down to about pagre		Application should show above content	Working as expected	Pass	NIL	N	-	Banuchandran , Bhuvaneshwaran , Karthick, Karthikeyan
ReportPage_TC_008	Report page	Report page	Verify user is able to see the report page content and able to report it.		Able to view and report issue.	Report test issue	Able to sub,it report	Working as expected	Pass	NIL	N	-	Banuchandran , Bhuvaneshwaran , Karthick, Karthikeyan

User Acceptance Testing

Defect analysis :

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	0	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	14	13	26	77

Test case analysis

Section	Total Cases	Not Tested	Fail	Pass
Client Application	13	0	0	13
Security	2	0	0	2
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	0	2

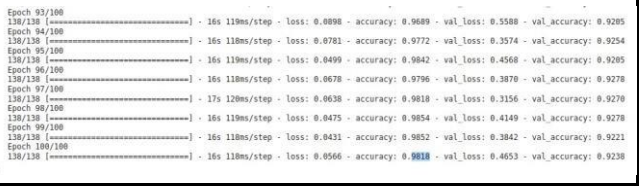
RESULTS

Performance metrics

Model Performance Testing:

S. No.	Parameter	Values	Screenshot

1	Model Summary	Total params: 9,767,489
		Trainable params: 9,767,489
		Non-trainable params: 0
			`classifier.summary()`
			`Model: "sequential_2"`
			Layer (type) / Output Shape / Param #
			conv2d_4 (Conv2D) — (None, 61, 61, 32) — 1568
			max_pooling2d_4 (MaxPooling2D) — (None, 30, 30, 32) — 0
			conv2d_5 (Conv2D) — (None, 27, 27, 32) — 16416
			max_pooling2d_5 (MaxPooling2D) — (None, 13, 13, 32) — 0
			flatten_2 (Flatten) — (None, 5408) — 0
			dense_14 (Dense) — (None, 200) — 1081800
			dense_15 (Dense) — (None, 500) — 100500
			dense_16 (Dense) — (None, 1000) — 501000
			dense_17 (Dense) — (None, 5000) — 5005000
			dense_18 (Dense) — (None, 600) — 3000600
			dense_19 (Dense) — (None, 100) — 60100
			dense_20 (Dense) — (None, 5) — 505
			`Total params: 9,767,489`
			`Trainable params: 9,767,489`
			`Non-trainable params: 0`

2	Accuracy	Training Accuracy - 98.18 Validation Accuracy - 92.38	

ADVANTAGES & DISADVANTAGES

ADVANTAGES :

- Classification of variety of fruits
- Accurate nutritional data about fruits
- Motivational quotes for fitness enthusiasts
- BMI management

DISADVANTAGES :

- System requirements
- Proper internet connection
- Only limited to fruits
- No support for nutritional values of fruits

CONCLUSION

In today's bustling society and availability of abundant resources online about fitness, tracking nutrition will become more challenging and inaccurate. There are a lot of misconceptions among people about fitness, and the lack of awareness about the nutritional values of food.

The purpose of the project is to provide web application to monitor and track their health condition and help the people to improve their health condition.

Future scope

- Implementation in PWA (Progressive web app)
- Extending functionality of providing nutritional values of fruits
- Drink water timely notification
- Sleep tracking
- Able to take real time photo and upload it
- Diet plan for users
- Personal online feed about fitness

Source Code

- https://github.com/IBM-EPBL/IBM-Project-10730-1659199664

GITHUB& Project Demo Link

Demo link : https://www.youtube.com/shorts/sL-81kvSroQ