M.A.M. College of Engineering,

Tiruchirappalli is approved by the AICTE, New Delhi and affiliated to Anna University, Chennai.

Department of Computer Science and Engineering

REPORT ON

HX 8001 PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP
(Nalaiya Thiran Program)

PROJECT TITLE

AI-Powered Nutrition Analyzer for Fitness Enthusiasts

TEAM ID: PNT2022TMID45438

MENTOR:

T M LATHA

TEAM MEMBERS:

1. Bharathi V (Team Leader)
2. Kaviya S
3. Priya V
4. Tharani P

TABLE OF CONTENTS

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

6.2 Sprint Delivery Schedule

7. CODING

7.1 Model Code

7.2 Database Schema (If Applicable)

8. RESULT

9.CONCLUSION

10. APPENDIX

GitHub & Project Demo Link

1.ABSTRACT

Artificial intelligence (AI) as a branch of computer science, the purpose of which is to imitate thought processes, learning abilities and knowledge management, finds more and more applications in experimental and clinical medicine. In recent decades, there has been an expansion of AI applications in biomedical sciences. The possibilities of artificial intelligence in the field of medical diagnostics, risk prediction and support of therapeutic techniques are growing rapidly. The aim of the article is to analyze the current use of AI in nutrition science research. The literature review was conducted in PubMed. A total of 399 records published between 1987 and 2020 were obtained, of which, after analyzing the titles and abstracts, 261 were rejected. In the next stages, the remaining records were analyzed using the full-text versions and, finally, 55 papers were selected. These papers were divided into three areas: AI in biomedical nutrients research (20 studies), AI in clinical nutrients research (22 studies) and AI in nutritional epidemiology (13 studies). It was found that the artificial neural network (ANN) methodology was dominant in the group of research on food composition study and production of nutrients. However, machine learning (ML) algorithms were widely used in studies on the influence of nutrients on the functioning of the human body in health and disease and in studies on the gut microbiota. Deep learning (DL) algorithms prevailed in a group of research works on clinical nutrients intake. The development of dietary systems using AI technology may lead to the creation of a global network that will be able to both actively support and monitor the personalized supply of nutrients.

2. INTRODUCTION

2.1 PROJECT DESCRIPTION

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 maintaining 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 build a model which is used for classifying the fruit depending 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 to the trained model. The model analyzes the image and detects the nutrition based on the fruits like (Sugar, Fibre, Protein, Calories, etc.).

2.2 Purposes

The AI model can be used as a reference for nutrition surveys and personal nutrition analysis. Nutritional intake is the basis for human growth and health, and the intake of different types of nutrients and micronutrients can affect health. Most diseases are inextricably linked to diet.

3. LITERATURE SURVEY

3.1 References

[1] Oscar Beijbom, Neel Joshi, Dan Morris, Scott Saponas, and Siddharth Khullar.2015. Menu-match: Restaurant-specic Food Logging from Images. In Proceedingsof the 2015 IEEE Winter Conference on Applications of Computer Vision. IEEE, 844–851.

[2] Yin Bi, Mingsong Lv, Chen Song, Wenyao Xu, Nan Guan, and Wang Yi. 2016.Autodietary: A Wearable Acoustic Sensor System for Food Intake Recognition inDaily Life. IEEE Sensors Journal 16, 3 (2016), 806–816.

[3] Jens Blechert, Adrian Meule, Niko A Busch, and Kathrin Ohla. 2014. Food-pics:An Image Database for Experimental Research on Eating and Appetite. Frontiersin Psychology 5 (2014), 617.

[4] Lukas Bossard, Matthieu Guillaumin, and Luc Van Gool. 2014. Food-101–MiningDiscriminative Components with Random Forests. In Proceedings of the 2014European Conference on Computer Vision. Springer, 446–461.

[5] Steven Cadavid, Mohamed Abdel-Mottaleb, and Abdelsalam Helal. 2012. Ex-ploiting Visual Quasi-periodicity for Real-time Chewing Event Detection UsingActive Appearance Models and Support Vector Machines. Personal and UbiquitousComputing 16, 6 (2012), 729–739.

[6] Micael Carvalho, Rémi Cadène, David Picard, Laure Soulier, Nicolas Thome, andMatthieu Cord. 2018. Cross-modal Retrieval in

the Cooking Context: LearningSemantic Text-image Embeddings. In Proceedings of the 41st International ACMSIGIR Conference on Research & Development in Information Retrieval. ACM, 35–44.

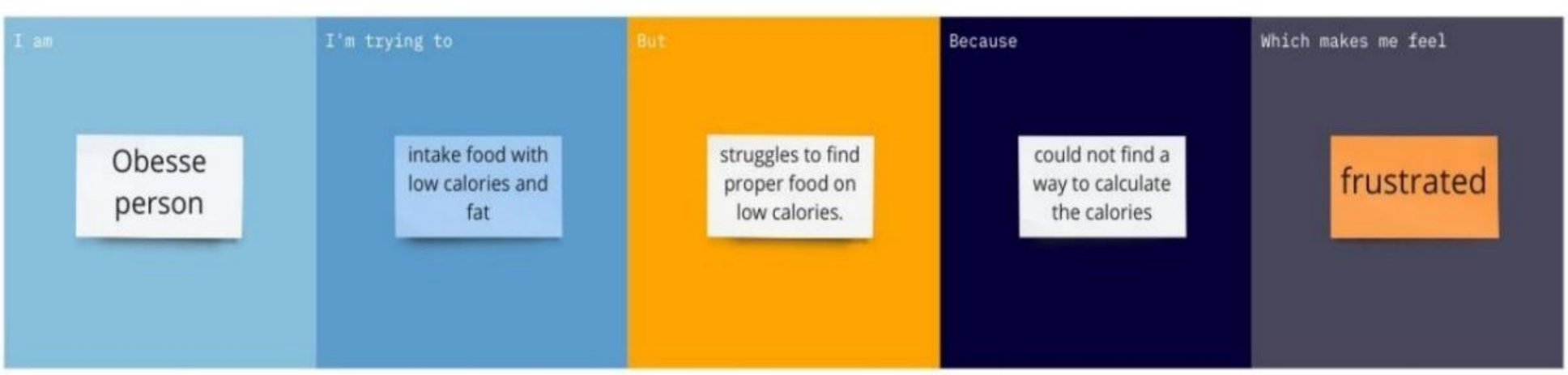
[7] Keng-hao Chang, Shih-yen Liu, Hao-hua Chu, Jane Yung-jen Hsu, Cheryl Chen,Tung-yun Lin, Chieh-yu Chen, and Polly Huang. 2006. The Diet-aware DiningTable: Observing Dietary Behaviors Over a Tabletop Surface. In Proceedings ofthe 2006 International Conference on Pervasive Computing. Springer, 366–382.

[8] Jingjing Chen and Chong-Wah Ngo. 2016. Deep-based Ingredient Recognition for Cooking Recipe Retrieval. In Proceedings of the 24th ACM International Conferenceon Multimedia. ACM, 32–41.

[9] Jing-jing Chen, Chong-Wah Ngo, and Tat-Seng Chua. 2017. Cross-modal RecipeRetrieval with Rich Food Attributes. In Proceedings of the 25th ACM InternationalConference on Multimedia. ACM, 1771–1779.

[10]Mei Chen, Kapil Dhingra, Wen Wu, Lei Yang, Rahul Sukthankar, and Jie Yang.2009. PFID: Pittsburgh Fast-food Image Dataset. In Proceedings of the 2009 IEEEInternational Conference on Image Processing (ICIP). IEEE, 289–292.

3.2 Problem Statement



Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	Sportsperson	stay fit	it is difficult to track calories in food	lack of knowledge on nutrients in food	helpless
PS-2	Commoner	intake nutritious food	cannot find a balanced diet	no quick access to nutritional information	dissatisfied
PS-3	Obesse Person	intake food with low calories	struggles to find food on low calories	could not find a way to calculate calories	dissatisfied

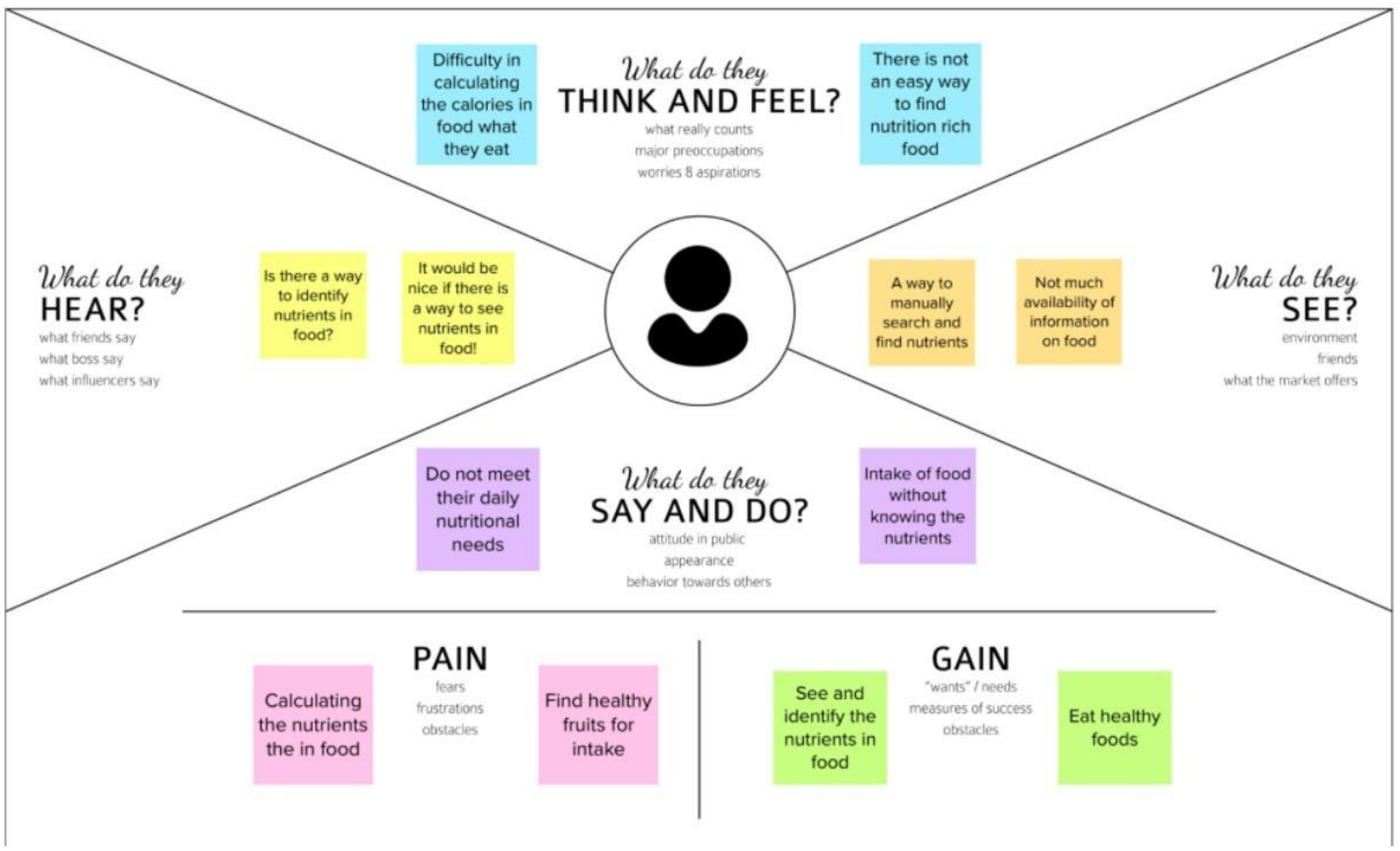
4. IDEATION & PROPOSED SOLUTION

4.1 Empathy Map Canvas

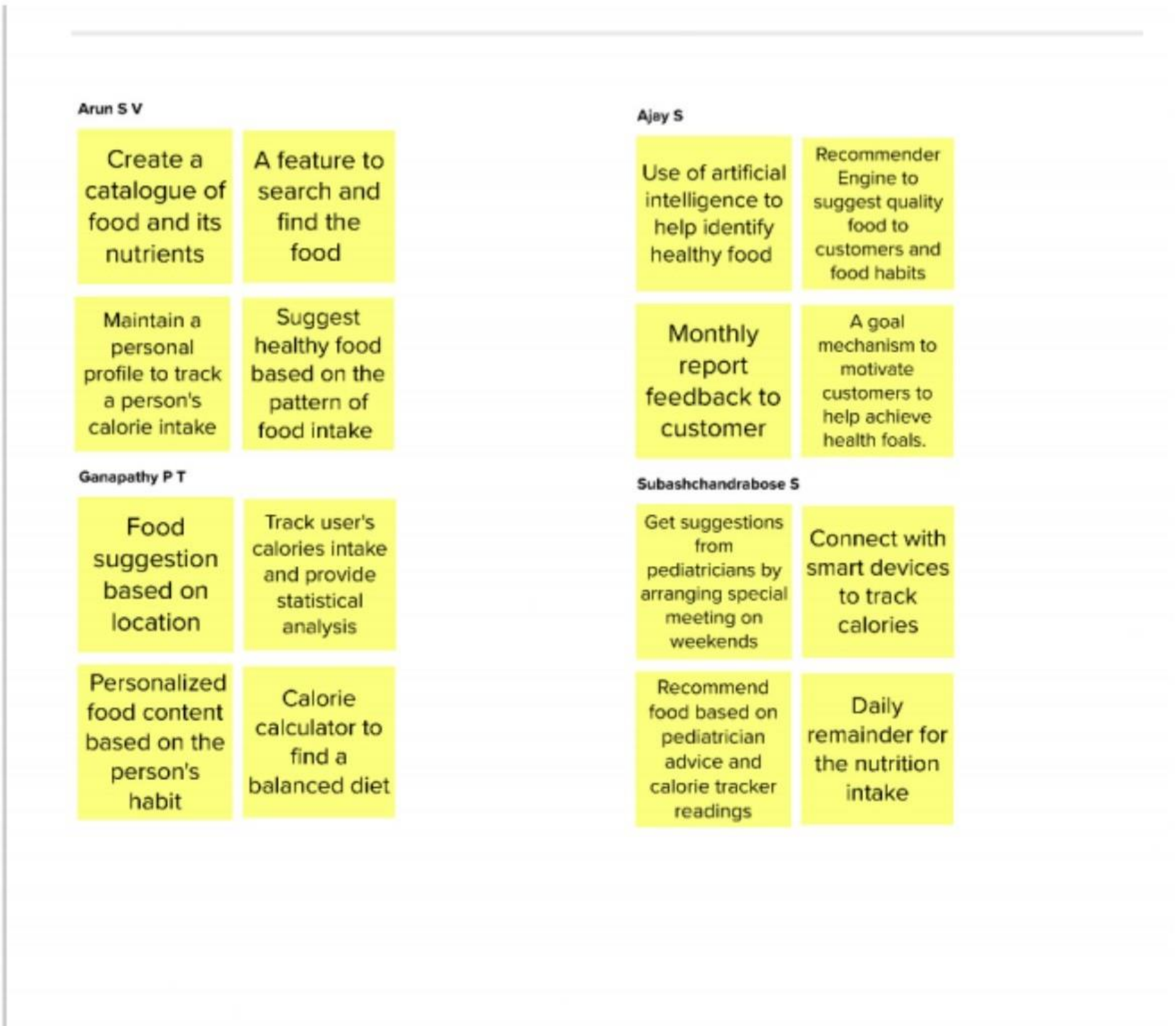
An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes.

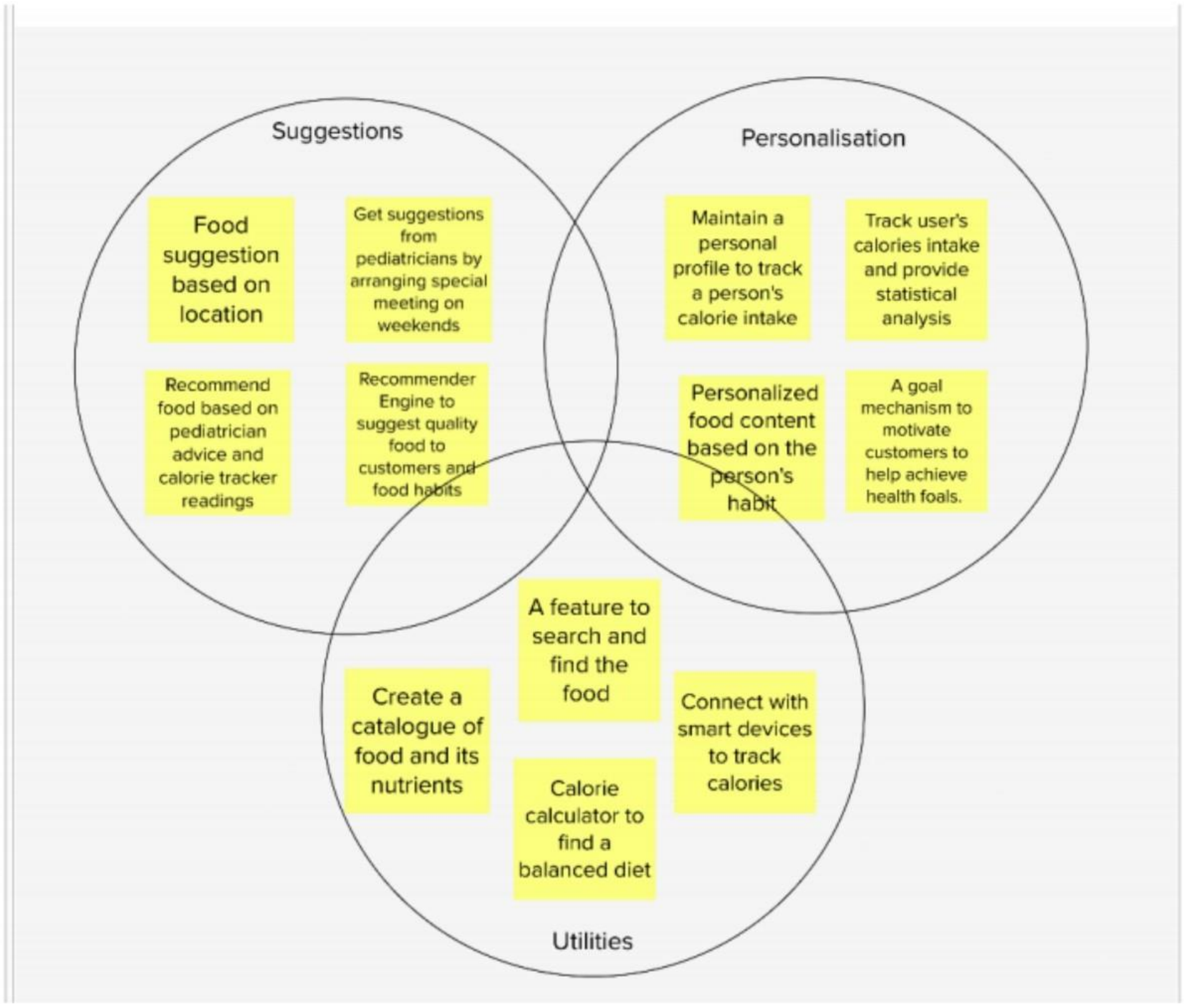
It is a useful tool to help teams better understand their users.

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.

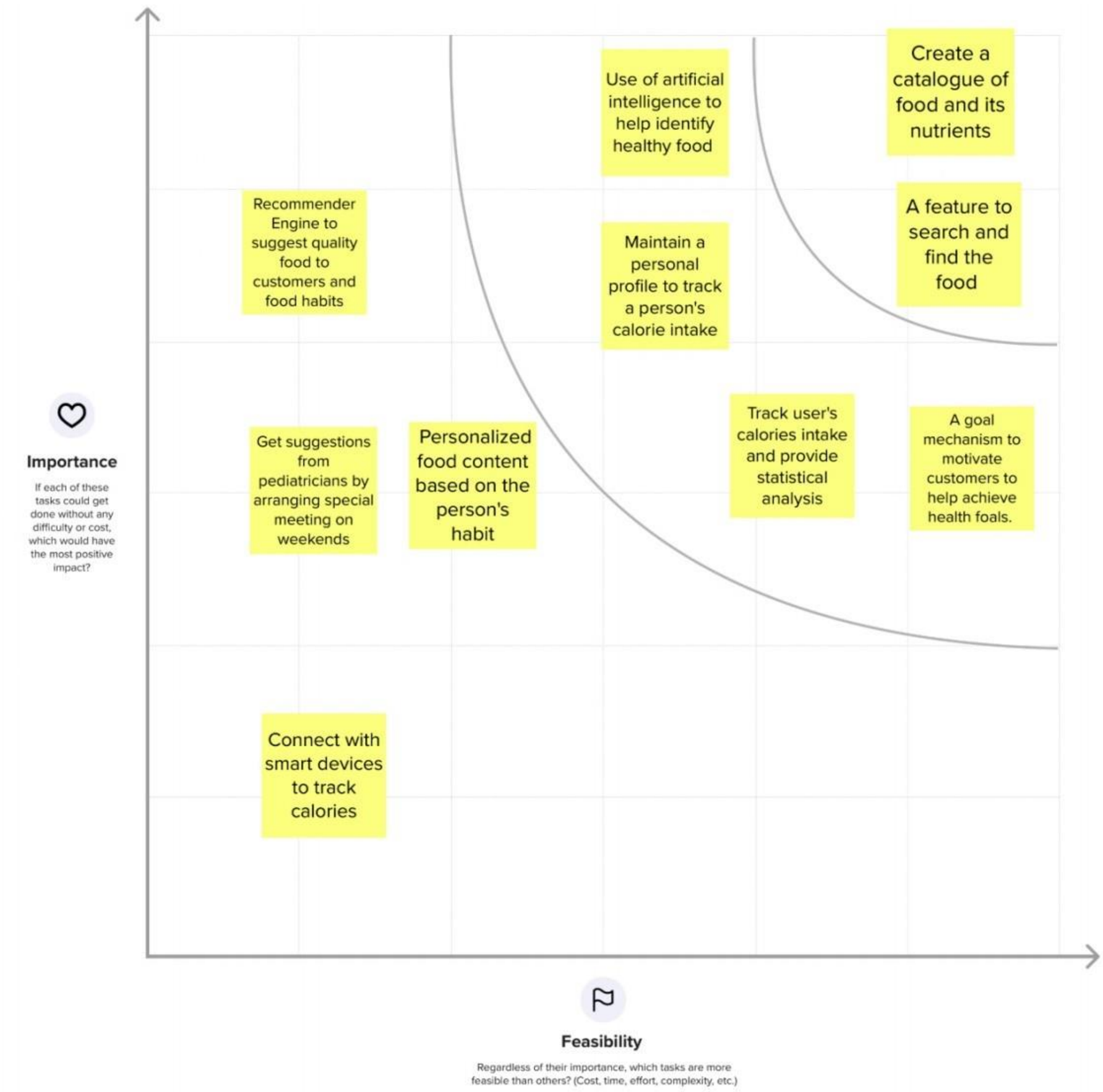


4.2 Ideation & Brainstorming





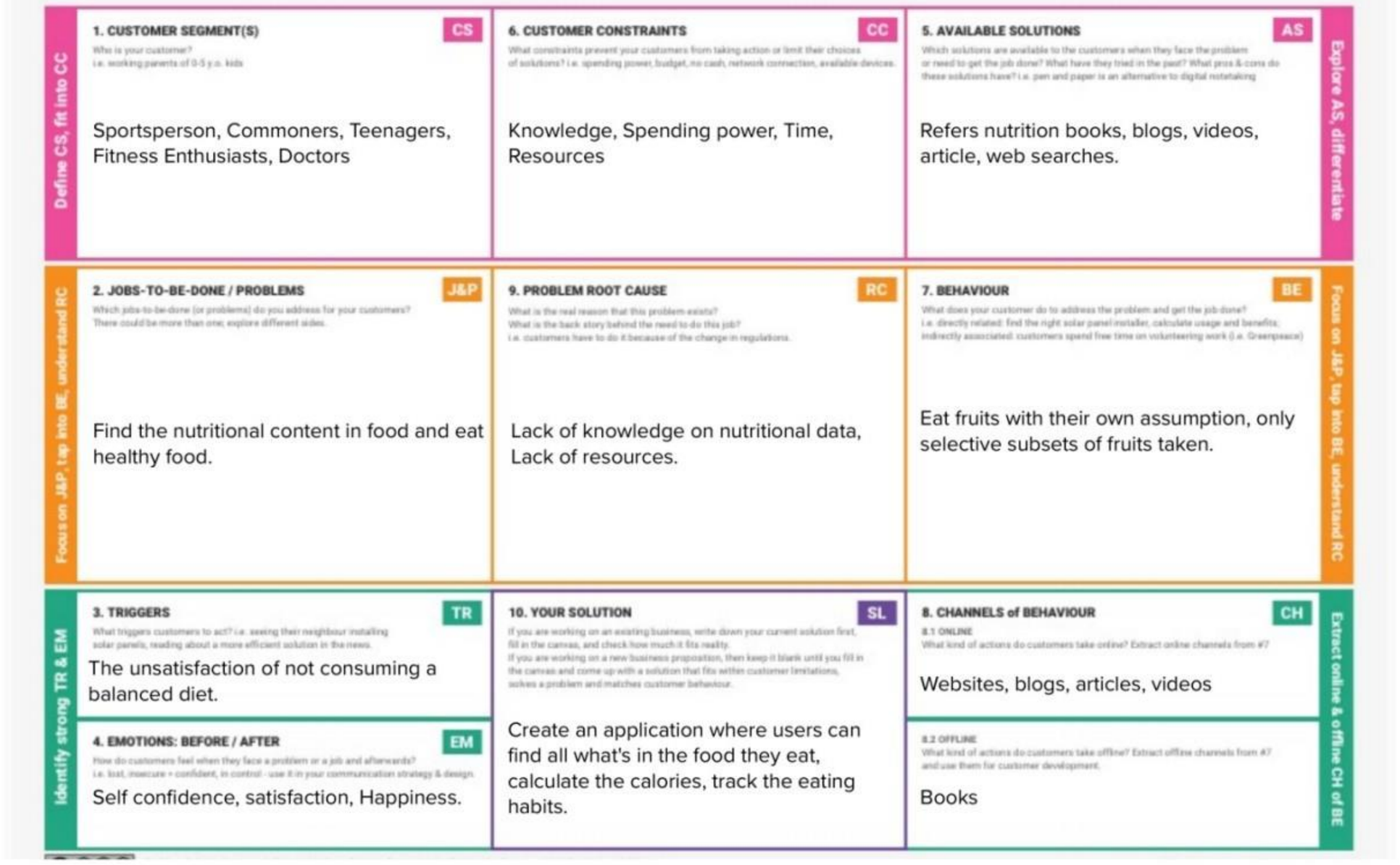
Idea Prioritization:



4.3 Proposed Solution

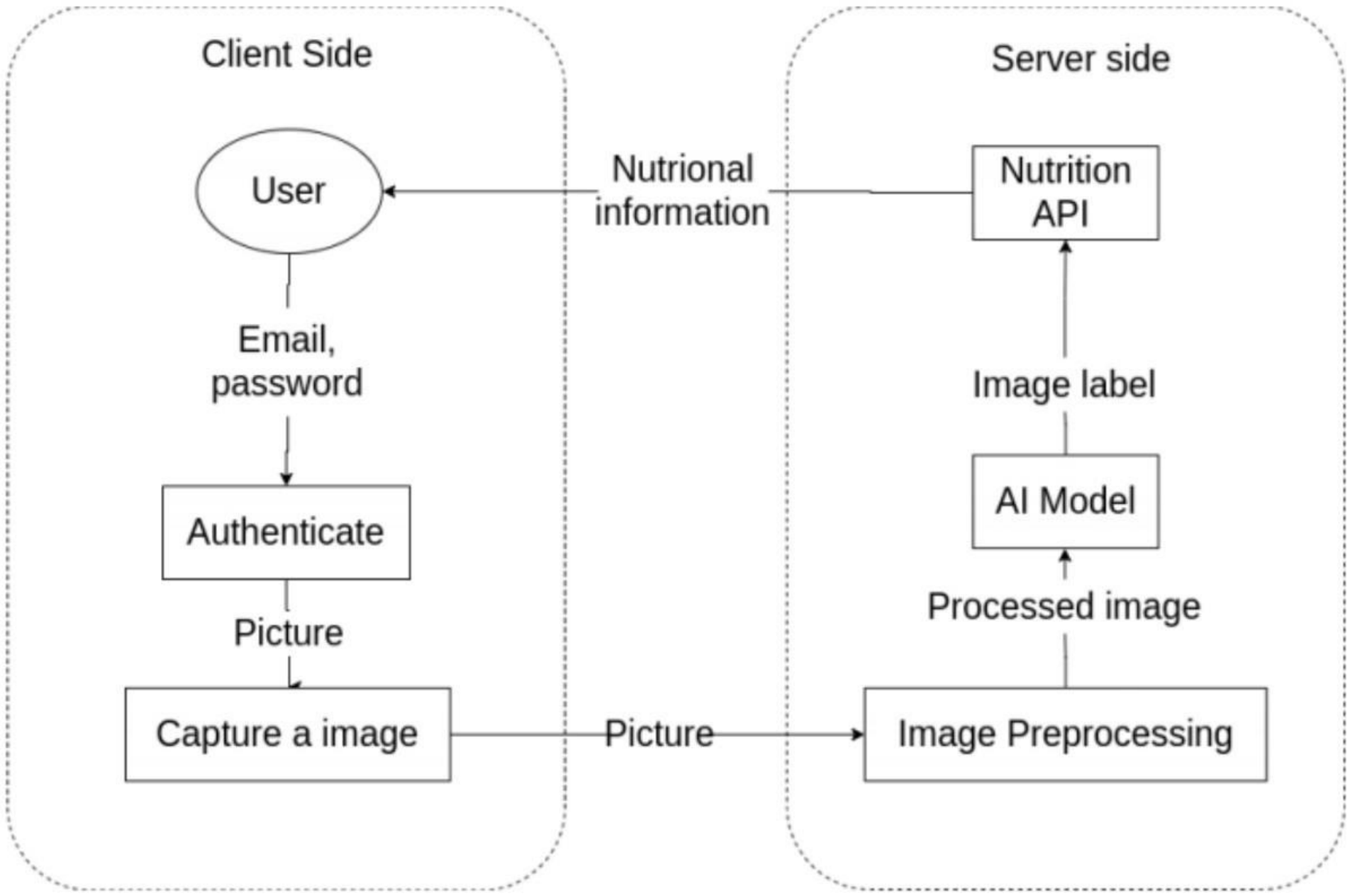
S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Find a way to identify and calculate the nutrients present in food items through computer vision.
2.	Idea / Solution description	Leveraging the advantage of transfer learning, use YOLO as a model to identify food with the image and with the help of an API get the nutritional content of food like calories, protein, fat, etc.
3.	Novelty / Uniqueness	Use of cutting edge technologies like artificial intelligence and computer vision leveraging the transfer learning technique.
4.	Social Impact / Customer Satisfaction	Aids people to consume healthy food. Enriches the life of people and also improves the lifestyle of the general public.
5.	Business Model (Revenue Model)	Can be monetized by providing this as a feature to other fitness organizations as an API.
6.	Scalability of the Solution	Can be extended by providing more personalized fitness assessment and recommendation to people on their food habits.

4.4 Problem Solution Fit

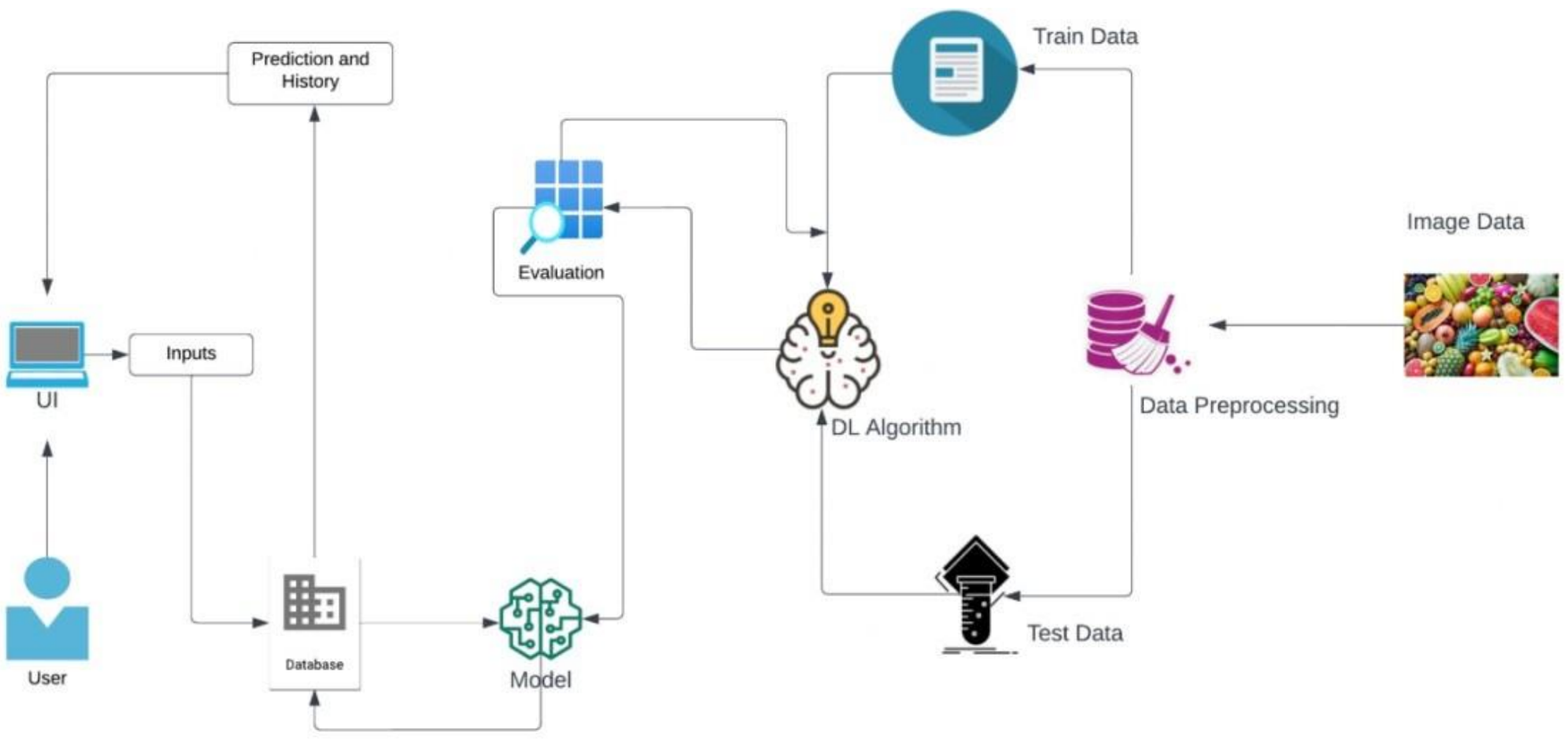

Define CS, fit into CC
1. CUSTOMER SEGMENT(S)
CS
Who is your customer?
i.e. working parents of 0-5 y.o. kids
Sportsperson, Commoners, Teenagers, Fitness Enthusiasts, Doctors
6. CUSTOMER CONSTRAINTS
CC
What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices.
Knowledge, Spending power, Time, Resources
5. AVAILABLE SOLUTIONS
AS
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
Refers nutrition books, blogs, videos, article, web searches.
Explore AS, differentiate
Focus on J&P, tap into BE, understand RC
2. JOBS-TO-BE-DONE / PROBLEMS
J&P
Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one, explore different sides.
Find the nutritional content in food and eat healthy food.
9. PROBLEM ROOT CAUSE
RC
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.
Lack of knowledge on nutritional data, Lack of resources.
7. BEHAVIOUR
BE
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)
Eat fruits with their own assumption, only selective subsets of fruits taken.
Focus on J&P, tap into BE, understand RC
Identify strong TR & EM
3. TRIGGERS
TR
What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.
The unsatisfaction of not consuming a balanced diet.
4. EMOTIONS: BEFORE / AFTER
EM
How do customers feel when they face a problem or a job and afterwards?
i.e. lost, insecure > confident, in control - use it in your communication strategy & design.
Self confidence, satisfaction, Happiness.
10. YOUR SOLUTION
SL
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.
Create an application where users can find all what's in the food they eat, calculate the calories, track the eating habits.
8. CHANNELS of BEHAVIOUR
CH
8.1 ONLINE
What kind of actions do customers take online? Extract online channels from #7
Websites, blogs, articles, videos
8.2 OFFLINE
What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.
Books
Extract online & offline CH of BE

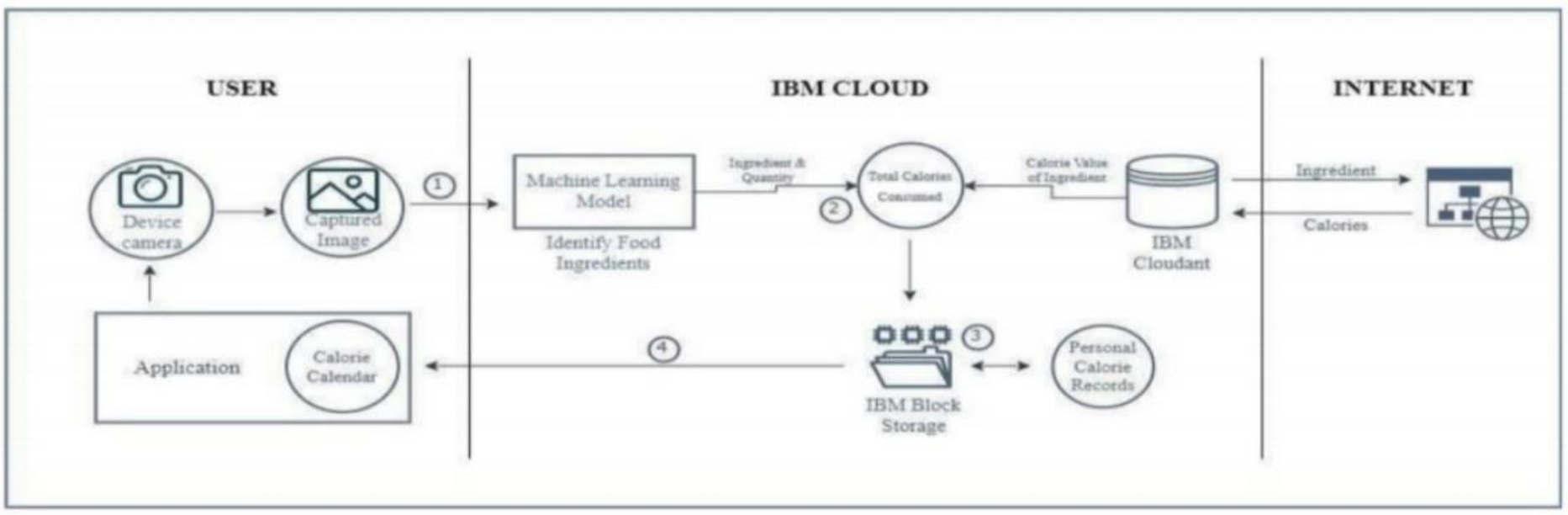
5. PROJECT DESIGN

5.1 Data Flow Diagram



5.2 Solution Architecture





5.3 Customer Journey Map

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	Food Vision	USN-1	As a user, I can upload a picture of a fruit/vegetable and find the name of it.	10	High	Ajay, Arun
Sprint-2	Nutritional Analyzer	USN-2	Map the identified food to the nutrients present in it.	5	Medium	Arun, Ganapathy
Sprint-2	Food Search	USN-3	As a user, I can search for a particular fruit/vegetable and find the nutrients in it	5	Medium	Ganapathy, Subash

Sprint-3	Registration	USN-4	As a user, I can register for the application by entering my email, password, and confirming my password.	5	Medium	Ganapathy, Subash
Sprint-3	Login	USN-5	As a user, I can log into the application by entering email & password	5	Medium	Ganapathy, Subash
Sprint-4	History	USN-6	As a user, I can see the food I took previously.	5	Low	Ajay, Subash
Sprint-4	Store	USN-7	As a user, I can store the fruits I uploaded a picture of.	5	Low	Arun, Ajay

6.2 Sprint Delivery Schedule

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	10	6 Days	24 Oct 2022	29 Oct 2022		
Sprint-2	10	6 Days	31 Oct 2022	05 Nov 2022		
Sprint-3	10	6 Days	07 Nov 2022	12 Nov 2022		
Sprint-4	10	6 Days	14 Nov 2022	19 Nov 2022		

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)

7. MODEL CODE

Import Required Packages

In [1]:
```
import numpy as np
import pandas as pd
from keras.preprocessing.image import ImageDataGenerator
```

Loading The Data

In [2]:
```
train_directory = 'Dataset/TRAIN_SET'
test_directory = 'Dataset/TEST_SET'
```

Data Agumentation

In [4]:
```
train_datagen = ImageDataGenerator(rescale=1./255,shear_range = 0.2,zoom_range=0.2,horizontal_flip=True)
test_datagen = ImageDataGenerator(rescale=1./255)
```

Performimg the Data Generation

In [5]:
```
#performing the data agumentation to training data
x_train = train_datagen.flow_from_directory(
train_directory,
target_size=(64,64),
color_mode='rgb',
batch_size=5,
class_mode='sparse',
)
```

```
Found 4118 images belonging to 5 classes.
```

In [6]:
```
#performing the data agumentation to testing data
x_test = train_datagen.flow_from_directory(
test_directory,
target_size=(64,64),
color_mode='rgb',
batch_size=5,
class_mode='sparse',
)
```

```
Found 929 images belonging to 5 classes.
```

In [7]:
```
print(x_train.class_indices)
```

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

In [8]:
```
print(x_test.class_indices)
```

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

Number of images for each class

In [11]:
```
from collections import Counter as c
print("Number of images in Training data : ", c(x_train.labels))
```

```
Number of images in Training data :  Counter({1: 1354, 2: 1019, 0: 995, 4: 475, 3: 275})
```

In [12]:
```
print("Number of images in Training data : ", c(x_test.labels))
```

```
Number of images in Training data :  Counter({1: 415, 0: 266, 2: 248})
```

In [ ]:
```

```

8. RESULT

The main aim of the project is to build a model which is used for classifying the fruit depending 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 to the trained model. The model analyzes the image and detects the nutrition based on the fruits like (Sugar, Fibre, Protein, Calories, etc.).

9. CONCLUSION

Based on evaluation metrics, the proposed model may outperform other algorithms used to predict nutritional status. The results of this study may direct patients to eat particular types of food to reduce the possibility of becoming infected with the diseases.

10. Appendix

In the Dietary Reference Intake (DRI) nutrient reports, the Adequate Intake (AI) has been estimated in a number of different ways. Because of this, the exact meanings and interpretations of the AIs differ. Some AIs have been based on the observed mean intake of groups or subpopulations that are maintaining health and nutritional status consistent with meeting the criteria for adequacy. However, where reliable information about these intakes was not available, or where there were conflicting data, other approaches were used. As a

result, the definition of an AI is broad and includes experimentally estimated desirable intakes.

These varying methods of setting an AI for assessing intakes of groups difficult. When the AI is based directly on intakes of apparently healthy population, it is correct to assume that other populations(with similar distributions of intakes) have a low prevalence of inadequate intakes if the mean intakes is at or above the AI. For nutrients for which the AI was not based on intakes of apparently healthy populations, a group mean intake at or above the AI would still indicate a low prevalence of inadequate intakes for that group but there is less confidence in this assessment.

Link
https://github.com/IBM-EPBL/IBM-Project-17662-1659674869