

Project report on

DemandEst - AI Powered Food Demand Forecaster

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1. INTRODUCTION

1.1 OVERVIEW

A food delivery service has to deal with a lot of perishable raw materials which makes it all, the most important factor for such a company is to accurately forecast daily and weekly demand. Too much inventory in the warehouse means more risk of wastage, and not enough could lead to out-of-stocks - and push customers to seek solutions from your competitors. The replenishment of the majority of raw materials is done on weekly basis and since the raw material is perishable, the procurement planning is of utmost importance, the task is to predict the demand for the next 10 weeks.

1.2 PURPOSE

The main aim of this project is to create an appropriate machine learning model to forecast then number of orders to gather raw materials for next ten weeks. To achieve this, we should know the information about of fulfillment center like area, city etc., and meal information like category of food, sub category of food, price of the food or discount in particular week. By using this data, we can use any classification algorithm to forecast the quantity for 10 weeks. For this a web application is built which is integrated with the model.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

The replenishment of the majority of raw materials is done on weekly basis and since the raw material is perishable, the procurement planning is of utmost importance. Also the recruiting of staff members at the fulfillment center is an prospect wherein the prediction of orders would be beneficial. Although this is a process that can be done manually.

2.2 REFERENCE

- Adi, G. N. (2018, March 9). Thousands of GO-CAR Drivers on Strike in Surakarta. The Jakarta Post. <https://www.thejakartapost.com/news/2018/03/08/thousands-of-go-car-drivers-on-strike-in-surakarta.html>
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- Colley, A., & Häkkinen, J. (2018, November). Service Design Methods for Human Computer Interaction. In Proceedings of the 17th International Conference on Mobile and Ubiquitous Multimedia (pp. 563-566).
- Clarke, S. (2006). Transformation Lessons from Coca-Cola Enterprises Inc.: Managing the Introduction of a Structured Forecast Process. Foresight: The International Journal of Applied Forecasting, (4), 21-25.

2.3 PROBLEM STATEMENT DEFINITION

Problem statement to understand your customer's point of view. The Customer Problem Statement template helps you focus on what matters to create experiences people will love.

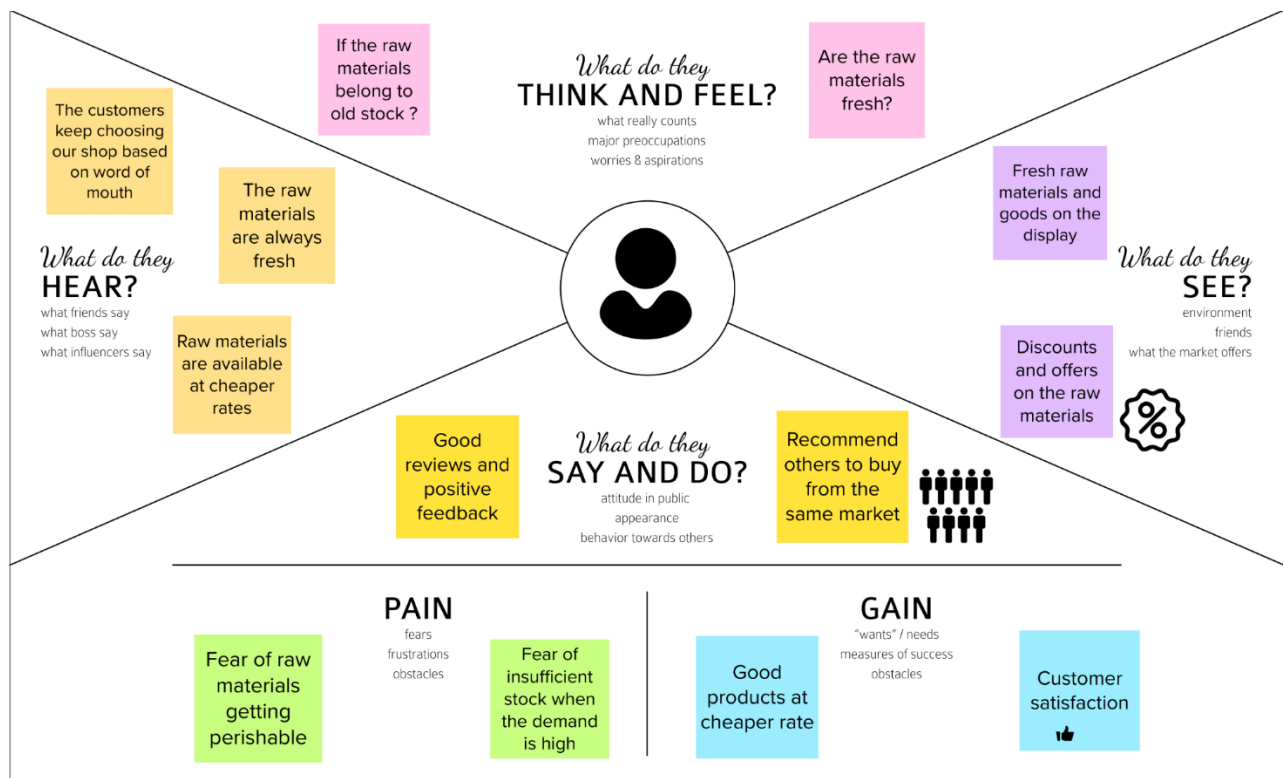
Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	Food Delivery Company	(i) buy raw materials. (ii) Plan to predict the demand.	(i) It leads to risk of wastage or out-of-stock. (ii) It takes long time to check the stock.	(i) They don't know the amount of raw materials to be purchased (ii) The prediction is not correct	(i) waste of cost. (ii) Frustrated.
PS-2	Restaurant	(i) Expect sales in a particular period of time. (ii) Predict the amount of sales done in a week.	(i) It is not correct in seasonal days. (ii) not to predict the amount of materials need to buy.	(i) In seasonal days more customers will come. (ii) It leads to out of stock or wastage.	(i) less profitability. (ii) Reduce turnover. (iii) To be complicated.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

An empathy map is a collaborative visualization used to articulate what we know about a particular type of user. It externalizes knowledge about users in order to 1) create a shared understanding of user needs, and 2) aid in decision making.

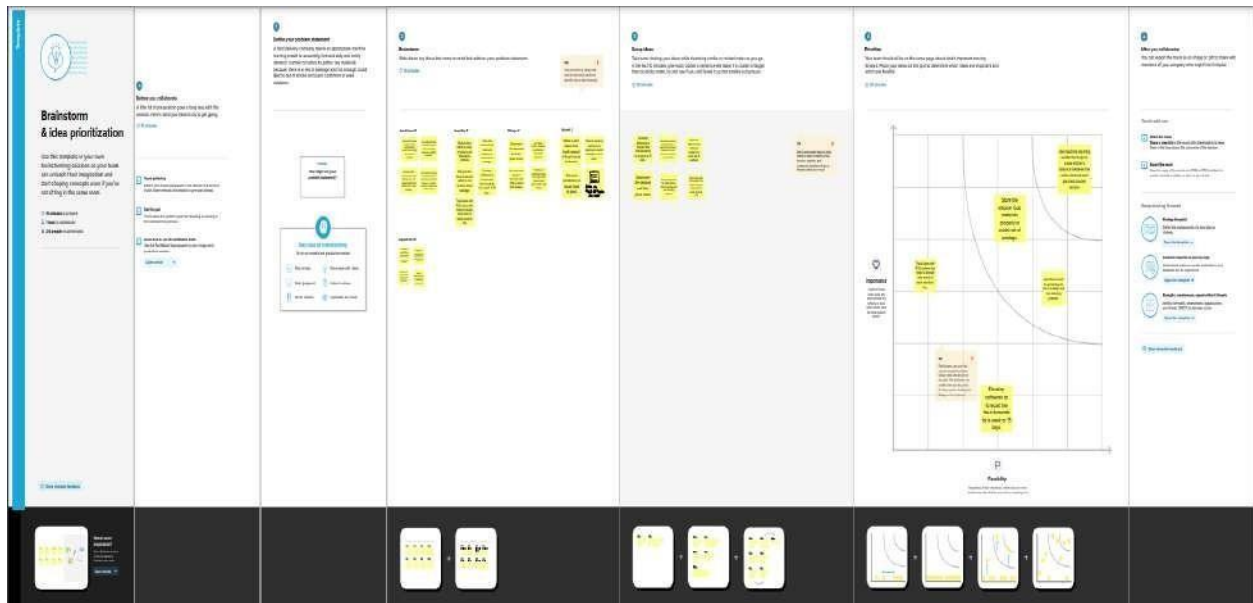
Traditional empathy maps are split into 4 quadrants (Says, Thinks, Does, and Feels), with the user or persona in the middle. Empathy maps provide a glance into who a user is as a whole and are not chronological or sequential.



3.2 Ideation & Brainstorming

Brainstorming is a method design teams use to generate ideas to solve clearly defined design problems. In controlled conditions and a free-thinking environment, teams approach a problem by such means as “How Might We” questions. They produce a vast array of ideas and draw links between them to find potential solutions

Everyone in a design team should have a *clear* definition of the target problem. They typically gather for a brainstorming session in a room with a large board/wall for pictures/Post-Its. A good mix of participants will expand the experience pool and therefore broaden the idea space.



3.2 Proposed Solution

Proposed Solution means the technical solution to be provided by the Implementation agency in response to the requirements and the objectives of the Project. Proposed Solution means the Proposed System with modifications that meet the Agency's requirements as set forth in this RFP. Proposed Solution means the combination of software, hardware, other products or equipment, and any and all services (including any installation, implementation, training, maintenance and support services) necessary to implement the solution described by Vendor in its Proposal.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	The challenge is to forecast demand for the upcoming 10 weeks because the majority of raw materials must be replenished on a weekly basis and are perishable, making procurement planning crucial.
2.	Idea / Solution description	This project's primary goal is to develop a suitable machine learning model to predict the volume of orders needed to procure raw materials over the following ten weeks.
3.	Novelty / Uniqueness	The client will be able to keep perishable raw supplies if the demand for the following 10 weeks can be accurately predicted. Second, precise demand estimates are quite beneficial when it comes to staffing the centres.
4.	Social Impact / Customer Satisfaction	A warehouse with too much inventory runs the danger of wastage, while one with too little could experience out-of-stocks, which would force clients to turn to your rivals for assistance. Therefore, our model will be able to address these issues with food delivery service centres.
5.	Business Model (Revenue Model)	By precisely forecasting the number of orders for the upcoming 10 weeks, this project will assist food delivery service centres in making the required preparations, such as purchasing perishable raw ingredients and staffing the centres, to prevent any form of losses.
6.	Scalability of the Solution	In order to support short- to medium-term production planning, the project focuses on applying methods to estimate consumer demand for products of a food company that targets the food service market.

3.4 Problem Solution Fit

The Problem-Solution Fit simply means that you have found a problem with your customer and that the solution you have realized for it actually solves the customer's problem.

Problem-Solution Fit canvas

Purpose / Vision

Version:

Define CS, fit into CL	1. CUSTOMER SEGMENT(S) CS People who provide food services are our customers.	6. CUSTOMER LIMITATIONS CL <small>EG. BUDGET, DEVICES</small> Customers can convey their requirements or their opinion through the website provided by our company	5. AVAILABLE SOLUTIONS AS <small>PLUSSES & MINUSES</small> Some of the solutions are predictive analysis, conjoint analysis, client intent surveys, and the Delphi Method of forecasting	Explore AS, differentiate
	2. PROBLEMS / PAINS + ITS FREQUENCY PR Demand planning without data can be futile. Too much inventory in the ware house means more risk of wastage, and not enough could lead to out of stock.	9. PROBLEM ROOT / CAUSE RC The problem is mainly caused due to the improper analysis of data and poor demand forecasting which may lead to loss of customers or it will give bad impression to the company.	7. BEHAVIOR + ITS INTENSITY BE When there is changes in consumer behaviour it is important to readjust to the market overall and optimize resources to stand out from the competition	
Identify strong TR & EM	3. TRIGGERS TO ACT TR It can control the food wastage in the society. Without a proper food prediction it would be a great loss.	10. YOUR SOLUTION SL By providing accurate and timely demand data according to the needs of the customer we can solve the problem. Increased customer satisfaction by timely fulfilling their requirements	8. CHANNELS of BEHAVIOR CH ONLINE Online users can deal with the industry through the website	Extract online & offline CH of BE
	4. EMOTIONS <small>BEFORE / AFTER</small> EM Unhealthy eating patterns can cause mood swings. Improper intake of food can cause dis-function of mind and bodies.		OFFLINE Offline users can directly visit the industry if there is any demand or requirement.	

Problem-Solution fit canvas is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License. Designed by Daria Nepriakhina / idea-hackers.nl - we tailor ideas to customer behaviour and increase solution adoption probability.

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4. REQUIREMENT ANALYSIS

4.1 Functional requirement

Functional requirements may involve calculations, technical details, data manipulation and processing, and other specific functionality that define what a system is supposed to accomplish. Behavioral requirements describe all the cases where the system uses the functional requirements, these are captured in use cases.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Home page	The user is directed to home page
FR-4	Sample use	The user would use the web application for calculating sample ideas so that he would get an idea of using it
FR-5	Adding sub users and creating network	The user would add his co-workers in his application page and form an network
FR-6	Feedback and support	After deployment , continuous customer support using the feedback

4.2 Non-Functional requirements

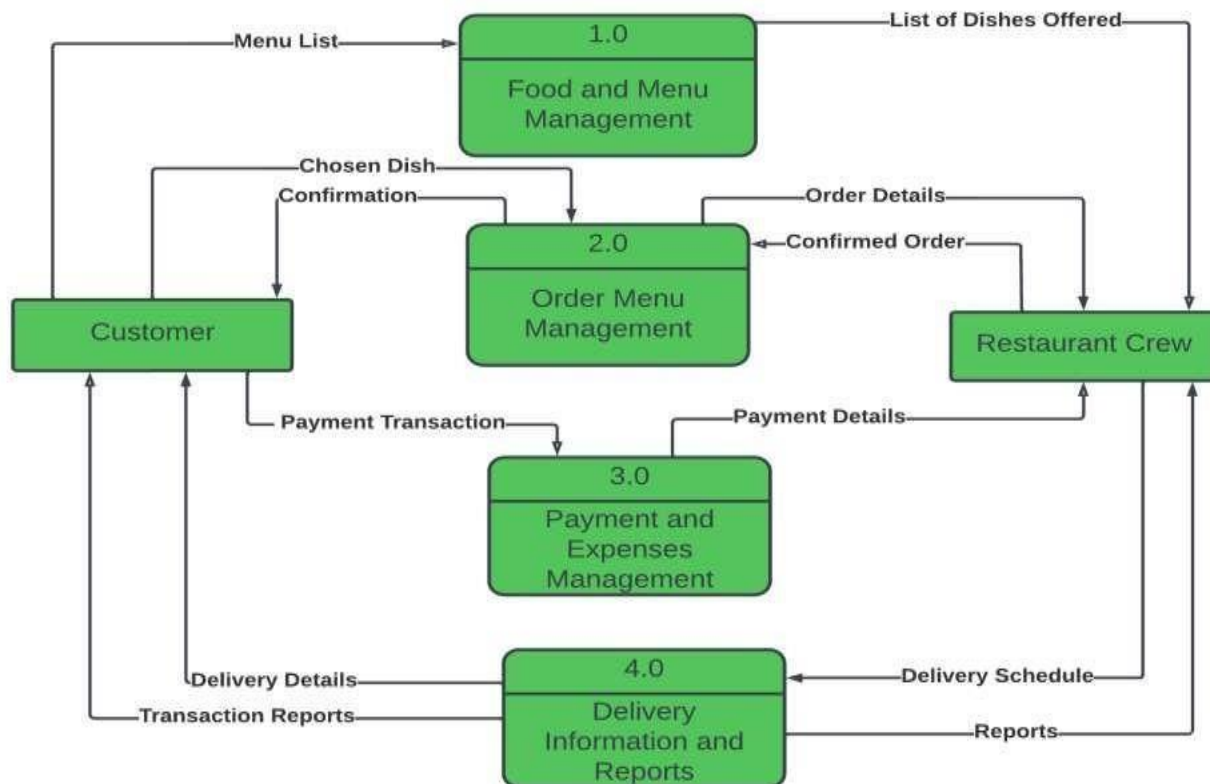
In systems engineering and requirements engineering, a non-functional requirement (NFR) is a requirement that specifies criteria that can be used to judge the operation of a system, rather than specific behaviours.

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The web application is required for the people working in food industry for calculating the required amount of food for a particular time period
NFR-2	Security	The passwords and emails of the users are stored in the encrypted form. Only if the password matches the encrypted form, the user would be able to access their database
NFR-3	Reliability	The data stored in the web application is safe as it needs the correct password and verification to access the stored information
NFR-4	Performance	The web application is designed in such a way that no matter how many users use at a time its performance remains the same and by using Advanced model and Ensemble Techniques performance is boosted
NFR-5	Availability	The web application is available in all platforms
NFR-6	Scalability	Ability to increase or decrease in performance and cost in response to changes in application and system processing demands.

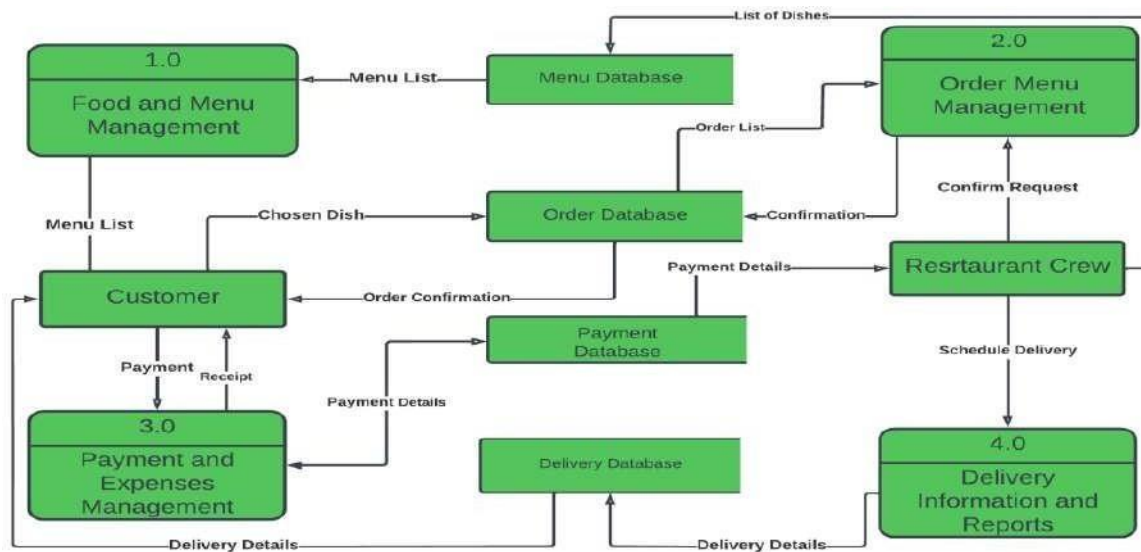
5. PROJECT DESIGN

5.1 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.



DATA FLOW DIAGRAM –LEVEL 1



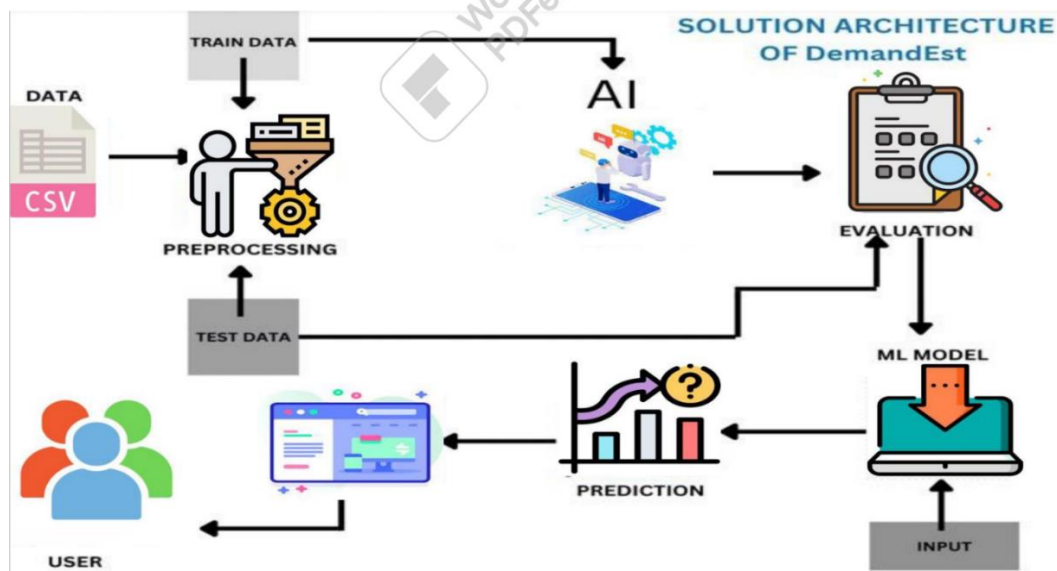
DATA FLOW DIAGRAM –LEVEL 2

5.2 Solution & Technical Architecture

Solution

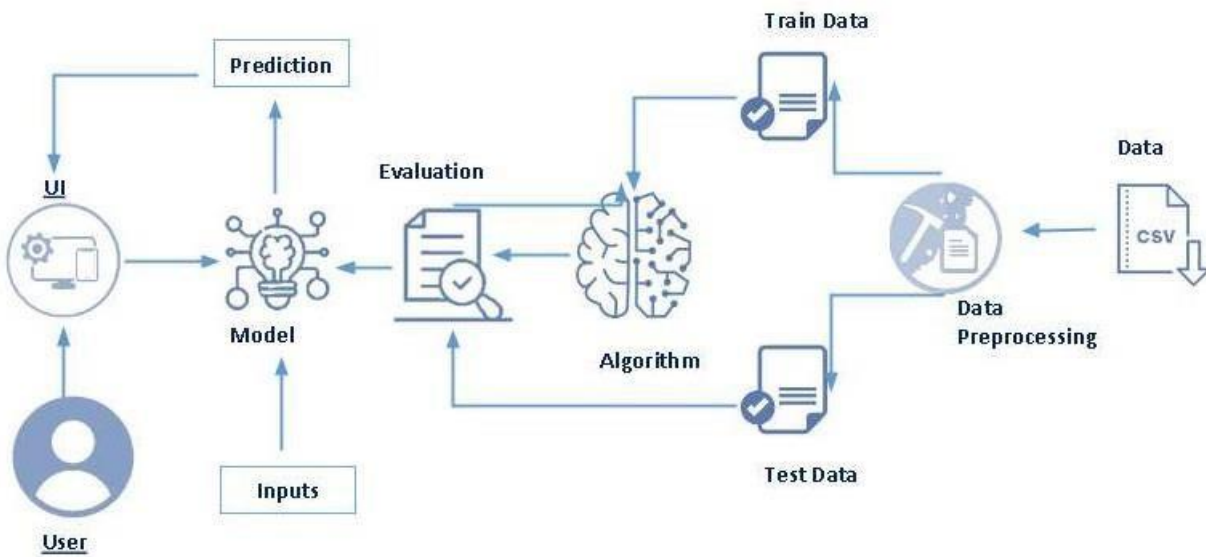
Architecture:

A solution architecture (SA) is an architectural description of a specific solution. SAs combine guidance from different enterprise architecture viewpoints (business, information and technical), as well as from the enterprise solution architecture (ESA).



Technical Architecture:

Technical Architecture (TA) is a form of IT architecture that is used to design computer systems. It involves the development of a technical blueprint with regard to the arrangement, interaction, and interdependence of all elements so that system-relevant requirements are met.



5.3 User Stories

A user story is an informal, general explanation of a software feature written from the perspective of the end user or customer. The purpose of a user story is to articulate how a piece of work will deliver a particular value back to the customer.

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
Business staff	Confirmation	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
Tourist People	Accessibility	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
College Students	Customer access through mail.	USN-4	As a user, I can register for the application through Gmail	I can confirm the order and get the OTP through email	Medium	Sprint-1
Customer (websites)	Login	USN-5	As a user, I can log into the application by entering email & password	I can log into the application to check either precise location or approximate location.	Medium	Sprint-2
	Dashboard	USN-6	Choosing the menu, Restaurant and payment process. after receiving the food rating process.	Hazard analysis and critical control point system.	Low	Sprint-1
Customer (Web user)	Customers Orders	USN-7	Delivery partner simply tracks the order and lets the customer know when it will arrive.	Tracking through GPS makes sure whether the given time slot is achieved.	Medium	Sprint-2
Customer Care Executive	Customer order delivery	USN-8	Doorstep delivery. easy process to get the order.	Rating on delivery partner and food quality.	Medium	Sprint-2
Administrator	Hotel management, website holders	USN-9	Choosing the restaurant. Multiple choice for restaurant profile.	Advertising through websites.	Low	Sprint-1

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

In Scrum Projects, Estimation is done by the entire team during Sprint Planning Meeting. The objective of the Estimation would be to consider the User Stories for the Sprint by Priority and by the Ability of the team to deliver during the Time Box of the Sprint.

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 by entering my email, password, and confirming my password.	2	High	Keerthana.D
Sprint-1	Conformation	USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	Janani.J
Sprint-2	Accessibility	USN-3	As a user, I can register for the application through Facebook	2	Low	Jeevitha.P
Sprint-1	Customer access through mail	USN-4	As a user, I can register for the application through Gmail	2	Medium	Dhivya.V
Sprint-2	Login	USN-5	As a user, I can log into the application by entering email & password	1	Medium	Jayashree.M
Sprint-1	Dashboard		Choosing the menu, Restaurant and payment process. after receiving the food rating process.	3	Low	Jeevitha.P
Sprint-2	Customers Orders	USN-7	Delivery partner simply tracks the order and lets the customer know when it will arrive.	12	Medium	Keerthana.D
Sprint-2	Customer order delivery	USN-8	Doorstep delivery. easy process to get the order.	3	Medium	Janani.J

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Hotel management, website holders	USN-7	Choosing the restaurant. Multiple choice for restaurant profile.	5	Low	Jayashree.M
Sprint-3	Maintenance	USN-1	As a administrator, I should be able to edit of the users of the app.	17	High	Dhivya.v
Sprint-4	Feedback	USN-6	As a customer care team member, I should be to get feedback from the users.	22	High	Jeevitha.P

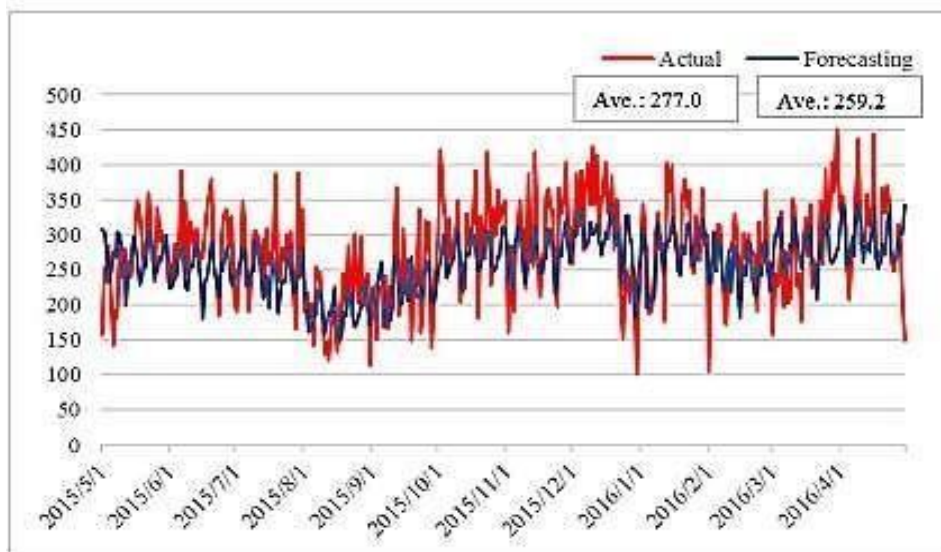
6.2 Sprint Delivery Schedule

A sprint schedule is a document that outlines sprint planning from end to end. It's one of the first steps in the agile sprint planning process—and something that requires adequate research, planning, and communication.

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	13	6 Days	19 Oct 2022	24 Oct 2022	13	24 Oct 2022
Sprint-2	18	6 Days	26 Oct 2022	31 Oct 2022	15	
Sprint-3	17	6 Days	02 Nov 2022	07 Nov 2022		
Sprint-4	22	6 Days	09 Nov 2022	14 Nov 2022		

6.3 Reports From JIRA

Jira helps teams plan, assign, track, report, and manage work and brings teams together for everything from agile software development and customer support to start-ups and enterprises. Software teams build better with Jira Software, the #1 tool for agile teams.



7. CODING & SOLUTIONING

7.1 Data Dictionary

Our base data consists of four csv files containing information about test data, train data and other required information.

- train.csv: Contains information like id, week, center id, meal id, checkout price, base price, emailer for promotion, homepage featured, number of orders. This file is used for training.

Variable	Definition
id	Unique ID
week	Week No
center_id	Unique ID for fulfillment center
meal_id	Unique ID for Meal
checkout_price	Final price including discount, taxes & delivery charges
base_price	Base price of the meal
emailer_for_promotion	Emailer sent for promotion of meal
homepage_featured	Meal featured at homepage
num_orders	(Target) Orders Count

- test.csv: Contains information like id, week, center id, meal id, checkout price,

base price, emailer for promotion, homepage featured. This file is used for testing.

- fulfilment_center_info.csv: Contains information of each fulfillment center.

Variable	Definition
center_id	Unique ID for fulfillment center
city_code	Unique code for city
region_code	Unique code for region
center_type	Anonymized center type
op_area	Area of operation (in km ²)

- meal_info.csv: Contains information of each meal being served.

Variable	Definition
meal_id	Unique ID for the meal
category	Type of meal (beverages/snacks/soups....)
cuisine	Meal cuisine (Indian/Italian/...)

7.2 Libraries Used pandas, numpy, scikit learn, matplotlib, seaborn, xgboost, lightgbm, catboost

7.3 Data Pre-Processing

- There are no Missing/Null Values in any of the three datasets.
- Before proceeding with the prediction process, all the three data sheets need to be merged into a single dataset. Before performing the merging operation, primary feature for combining the datasets needs to be validated.
- The number of Center IDs in train dataset is matching with the number of Center IDs in the Centers Dataset i.e 77 unique records. Hence, there won't be any missing values while merging the datasets together.

- The number of Meal IDs in train dataset is matching with the number of Meal IDs in the Meals Dataset i.e 51 unique records. Hence, there won't be any missing values while merging the datasets together.
- As checked earlier, there were no Null/Missing values even after merging the datasets.

7.4 Feature Engineering

Feature engineering is the process of using domain knowledge of the data to create features that improves the performance of the machine learning models.

With the given data, We have derived the below features to improve our model performance.

- Discount Amount : This defines the difference between the “base_Price” and “checkout_price”.
- Discount Percent : This defines the % discount offer to customer.
- Discount Y/N : This defines whether Discount is provided or not - 1 if there is Discount and 0 if there is no Discount.
- Compare Week Price : This defines the increase / decrease in price of a Meal for a particular center compared to the previous week.
- Compare Week Price Y/N : Price increased or decreased - 1 if the Price increased and 0 if the price decreased compared to the previous week.
- Quarter : Based on the given number of weeks, derived a new feature named as Quarter which defines the Quarter of the year.
- Year : Based on the given number of weeks, derived a new feature named as Year which defines the Year.

7.5 Data Transformation

- Logarithm transformation (or log transform) is one of the most commonly used mathematical transformations in feature engineering. It helps to handle skewed data and after transformation, the distribution becomes more approximate to normal.
- In our data, the target variable ‘num_orders’ is not normally distributed. Using this without applying any transformation techniques will downgrade the performance of our model.
- Therefore, we have applied Logarithm transformation on our Target feature ‘num_orders’ post which the data seems to be more approximate to normal distribution.
- After Log transformation, We have observed 0% of Outlier data being present within the Target Variable – num_orders using 3 IQR Method.

7.6 Evaluation Metric

The evaluation metric for this competition is 100*RMSLE where RMSLE is Root of Mean Squared Logarithmic Error across all entries in the test set.

7.7 Initial Approach

- Simple Linear Regression model without any feature engineering and data transformation which gave a RMSE : 194.402
- Without feature engineering and data transformation, the model did not perform well and couldn't give a good score.
- Post applying feature engineering and data transformation (log and log1p transformation), Linear Regression model gave a RMSLE score of 0.634.

7.8 Advanced Models

- With improvised feature engineering, built advanced models using Ensemble techniques and other Regressor algorithms.
- Decision Tree Regressors performed well on the model which gave much reduced RMSLE.
- With proper hyper-parameter tuning, Decision Tree Regressor performed well on the model and gave the least RMSLE of 0.5237

8. TESTING

8.1 Test Cases

A test case includes information such as test steps, expected results and data while a test scenario only includes the functionality to be tested.

Test case ID	Feature Type	Component	Test Scenario
LoginPage_TC_OO1	Functional (Registration)	Home Page	As a user, I can register for the application by entering my email, password, and confirming my password.
LoginPage_TC_OO2	Functional (Conformation)	Home Page	As a User, I will receive confirmation email once I have registered for the application.
LoginPage_TC_OO3	Functional (Accessibility)	Home page	As a user, I can register for the application through Facebook
LoginPage_TC_OO4	Functional (Customer access through mail)	Login page	As a user, I can register for the application through Gmail.
LoginPage_TC_OO4	Functional (Login)	Login page	As a user, I can log out into the application by entering email & password.
LoginPage_TC_OO5	Functional (Dashboard)	Home page	Choosing the menu, Restaurant and payment process. after receiving the food rating process.
LoginPage_TC_OO6	Functional (Customers order)	Home page	Delivery partner simply tracks the order and lets the customer know when it will arrive.
LoginPage_TC_OO7	Functional (Customer order delivery)	Home page	Doorstep delivery. Easy process to get the order.
LoginPage_TC_OO8	Functional (Hotel Management)	Home page	Choosing the restaurant. Multiple choice for restaurant profile.

Pre-Requisite	Steps To Execute
Network Accessing device	<ol style="list-style-type: none"> 1.Check all the text boxes, radio buttons, buttons,etc. 2.Check the required fields by not filling any data. 3.Check user should Register by filling all the required fields.
Network Accessing device	<ol style="list-style-type: none"> 1. Check results on entering valid user ID & Password. 2. Check results on entering invalid User ID & Password. 3. Check response when a user ID is empty & login button is pressed, and many more.
Network Accessing device	<ol style="list-style-type: none"> 1.If the labels are correctly written and placed or not. 2.If the audio/video content is properly audible/visible or not. 3.If the color contrast ratio is maintained or not. 4.If the control actions for video are working fine or
Network Accessing device	<ol style="list-style-type: none"> 1.Enter URL(http://127.0.0.1:5000/) and click go 2.Click on My Account dropdown button 3.Enter Invalid username/email in Email text box 4.Enter valid password in password text box 5.Click on login button
Network Accessing device	<ol style="list-style-type: none"> 1.Log in with valid credentials. 2.Check the show password feature. 3.Check the Remember Me checkbox. 4.Check the email. 5.Click on login button
Network Accessing device	<ol style="list-style-type: none"> 1.Test Case ID. 2.Test Description. 3.Assumptions and Pre-Conditions. 4.Test Data.
Network Accessing device	<ol style="list-style-type: none"> 1. Keep things simple and transparent. 2. Make test cases reusable. 3. Peer review is important. 4. Keep test cases IDs unique.
Network Accessing device	<ol style="list-style-type: none"> 1. Making sure that functionalities are easy to find 2. Navigation should be easy and user-friendly 3. Buttons of the application should be visible. 4. Verification that font should be of appropriate size so that anyone can read them.
Network Accessing device	<ol style="list-style-type: none"> 1. Making sure that functionalities are easy to find 2. Navigation should be easy and user-friendly 3. Buttons of the application should be visible. 4. Verification that font should be of appropriate size so that anyone can read them.

Test Data	Expected Result	Actual Result	Status
http://127.0.0.1:5000	Login/Signup popup should display	Working as expected	Pass
http://127.0.0.1:5000	Application should show below UI elements: a.email text box b.password text box c.Login button with orange colour d.New customer? Create account link	Working as expected	Pass
Username: jdk@gmail.com password: FDF123	User should navigate to user account homepage	Working as expected	Pass
Username: jdk@gmail password: FDF123	Application should show 'Incorrect email or password ' validation message.	Working as expected	Pass
Username: jdk@gmail.com password: FDF123678686786876876	Application should show 'Incorrect email or password ' validation message.	Working as expected	Pass
Username: jdk password: FDF123678686786876876	Application should show 'Incorrect email or password ' validation message.	Working as expected	Pass
Username: jdk@gmail password: FDF123	Everything that a customer expects from a product, service or organisation.	Working as expected	Pass
Username: jdk@gmail password: FDF123	It should be made clear how many days a delivery might take to process.	Working as expected	Pass
Username: jdk@gmail password: FDF123	It will be commercially accountable for budgeting and financial management and will need to plan, organise and direct all hotel services.	Working as expected	Pass

8.2 User Acceptance Testing

User Acceptance Testing (UAT), which is performed on most UIT projects, sometimes called beta testing or end-user testing, is a phase of software development in which the software is tested in the "real world" by the intended audience or business representative.

Defect Analysis:

Resolution	Severity1	Severity2	Severity3	Severity4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won'tFix	0	0	0	1	1
Totals	24	9	11	26	71

Test Case Analysis:

Section	TotalCases	Not Tested	Fail	Pass
PrintEngine	7	0	0	7
ClientApplication	51	0	0	51
Security	2	0	0	2
OutsourceShipping	3	0	0	3
ExceptionReporting	9	0	0	9
FinalReportOutput	4	0	0	4
VersionControl	2	0	0	2

9. RESULTS

9.1 Performance Metrics

Performance testing is the practice of evaluating how a system performs in terms of responsiveness and stability under a particular workload. Performance tests are typically executed to examine speed, robustness, reliability, and application size.

S.No.	Parameter	Values	Screenshot
1.	Metrics	Regression Model: MAE 89.10334778841495, MSE - 43129.82977026746, RMSLE -207.67722496765856, R2 score -0.6946496854280233,	<p>Evaluating the model</p> <pre>In [33]: from sklearn.metrics import mean_squared_error</pre> <pre>In [34]: RMSE=np.sqrt(mean_squared_error(y_test,pred)) RMSE</pre> <pre>Out[34]: 209.71961740201198</pre> <pre>In [39]: from sklearn import metrics from sklearn.metrics import mean_absolute_error</pre> <pre>In [40]: MSE=print(metrics.mean_squared_error(y_test,pred)) MSE</pre> <pre> 43982.31792324628</pre> <pre>In [41]: R2S=print(metrics.r2_score(y_test,pred)) R2S</pre> <pre> 0.6886142448276894</pre> <pre>In [42]: MAE=print(mean_absolute_error(y_test,pred))</pre> <pre> 89.10334778841495</pre>

2.	Tune the Model	<h3>Hyperparameter Tuning -</h3> <p>RMSLE- 52.85812511759974 avg R-squared- 0.123 MSE: -64230.918</p>	<pre>> [38]: print("R-squared: {}".format(grid_cv_best_score)) print("best hyperparameters: {}".format(grid_cv_best_params)) R-squared: 0.12311759974 best hyperparameters: {'max_leaf_nodes': None, 'min_samples_leaf': 4, 'min_samples_split': 10} > [39]: # Fit the trained estimator on the cv results df_best Out[39]:</pre> <table><thead><tr><th></th><th>max_depth</th><th>min_depth</th><th>max_leaf_nodes</th><th>min_samples_leaf</th><th>min_samples_split</th><th>score</th></tr></thead><tbody><tr><td>0</td><td>51467</td><td>10520</td><td>10000</td><td>10000</td><td>None</td><td>1</td></tr><tr><td>1</td><td>43200</td><td>14910</td><td>10000</td><td>10000</td><td>None</td><td>1</td></tr><tr><td>2</td><td>41891</td><td>13200</td><td>10000</td><td>10000</td><td>None</td><td>1</td></tr><tr><td>3</td><td>41404</td><td>10840</td><td>10000</td><td>10000</td><td>None</td><td>1</td></tr><tr><td>4</td><td>41720</td><td>17960</td><td>10000</td><td>10000</td><td>None</td><td>1</td></tr></tbody></table> <pre>> [40]: cv_scores = cross_val_score(grid_cv_best_estimator, X, y, cv=10) best_score = cross_val_score(grid_cv_best_estimator, X, y, cv=10, scoring='neg_mean_squared_error') print("log R-squared: {}".format(np.mean(cv_scores))) print("MSE: {}".format(np.mean(best_score))) avg R-squared: 0.123 MSE: -64230.918 > [41]: grid_cv_best_estimator.fit(train, y_train) y_pred = grid_cv_best_estimator.predict(test) y_pred[y_pred] = 0 from sklearn import metrics print("RMSLE", metrics.mean_squared_log_error(test, y_pred)) RMSLE: 52.85812511759974 > [42]:</pre> <h3>Tuning the model Using GridSearchCV</h3> <pre>> [43]: from sklearn import preprocessing from sklearn.model_selection import GridSearchCV, cross_val_score, cross_val_predict import sklearn as sk import matplotlib.pyplot as plt plt.style.use('darkgrid') plt.rcParams['font.size'] = 14 params = {'logistic_regression__C': [1, 10, 100, 1000], 'logistic_regression__l1_penalty': [0, 1, 10, 100], 'logistic_regression__l2_penalty': [0, 1, 10, 100], 'logistic_regression__max_iter': [100, 200, 300, 400, 500], 'logistic_regression__tol': [1e-4, 1e-5, 1e-6, 1e-7], 'logistic_regression__warm_start': [False, True]} grid_cv_best = GridSearchCV(estimator=logistic_regression, param_grid=params) > [44]: param_grid = {'logistic_regression__C': [1, 10, 100, 1000], 'logistic_regression__l1_penalty': [0, 1, 10, 100], 'logistic_regression__l2_penalty': [0, 1, 10, 100], 'logistic_regression__max_iter': [100, 200, 300, 400, 500], 'logistic_regression__tol': [1e-4, 1e-5, 1e-6, 1e-7], 'logistic_regression__warm_start': [False, True]} grid_cv_best = GridSearchCV(estimator=logistic_regression, param_grid=param_grid, cv=5) grid_cv_best.fit(train, y_train) Out[45]: GridSearchCV(estimator=LogisticRegression(), param_grid={'logistic_regression__C': [1, 10, 100, 1000], 'logistic_regression__l1_penalty': [0, 1, 10, 100], 'logistic_regression__l2_penalty': [0, 1, 10, 100], 'logistic_regression__max_iter': [100, 200, 300, 400, 500], 'logistic_regression__tol': [1e-4, 1e-5, 1e-6, 1e-7]})</pre>		max_depth	min_depth	max_leaf_nodes	min_samples_leaf	min_samples_split	score	0	51467	10520	10000	10000	None	1	1	43200	14910	10000	10000	None	1	2	41891	13200	10000	10000	None	1	3	41404	10840	10000	10000	None	1	4	41720	17960	10000	10000	None	1
	max_depth	min_depth	max_leaf_nodes	min_samples_leaf	min_samples_split	score																																							
0	51467	10520	10000	10000	None	1																																							
1	43200	14910	10000	10000	None	1																																							
2	41891	13200	10000	10000	None	1																																							
3	41404	10840	10000	10000	None	1																																							
4	41720	17960	10000	10000	None	1																																							

10. ADVANTAGES & DISADVANTAGES

Advantages:

1. Food wastage will be minimized.
2. Simple and easy to use framework.

Disadvantages: 1. The output obtained may not be precised, due to the use of limited datasets.

11. APPLICATIONS

This project focuses on one food delivery client, which delivers food in many different cities through distribution networks and fulfillment centers.

12. CONCLUSION

The main moto behind this project is to reduce food wastage. The availability of the food items makes the society better. Our purposed model would definitely come handy to a company for predicting then number of food orders and help them to serve their customers better.

13. FUTURE SCOPE

1. Working on the frontend to make the framework more dynamic.
2. In the future, we also plan to improve forecasting accuracy and research on the efficiency of store management.

14. APPENDIX

SOURCE CODE: home.html

```
<!DOCTYPE html>
<html> <head>
<title>Home</title>
<style> .navbar { margin:
0px;          padding:20px;
background-color:white;
opacity:0.6;   color:black;
font-family:'Roboto',sans-
serif;  font-style:  italic;
border-radius:20px;  font-
size:25px; } a { color:grey;
float:right;        text-
decoration:none;     font-
style:normal;        padding-
right:20px;  } a:hover{
background-color:black;
color:white;         border-
```



```

radius:15px;0 font-size:30px;
padding-left:10px;
} p {
color:white;
font-
style:italic;
font-size:30px;
} body
{
background-image:      url("https://img.freepik.com/free-photo/grilled-chicken-rice-spicy-
chickpeasavocado-cabbage-pepper-buddha-bowl-dark-top-view_127032-
1966.jpg?w=2000"); background-size: cover;
}
</style>
</head>
<body>
<div class="navbar">
<a href="/pred">Predict</a>
<a href="/home">Home</a>
<br>
</div>
<br>
<center><b><font color="yellow" size="15" font-family="Comic Sans MS" >Food Demand
Forecasting</font></b></center>
<div>
<br>
<center>
<p>A food delivery service has to deal with a lot of perishable raw materials which makes it all,
the most important factor for such a company is to accurately forecast daily and weekly demand.
Too much inventory in the warehouse means more risk of wastage, and not enough could lead to
out-of-stocks - and push customers to seek solutions from your competitors. The replenishment of
majority of raw materials is done on weekly basis and since the raw material is perishable, the
procurement planning is of utmost importance, the task is to predict the demand for the next 10
weeks.</p> </center>
</div>
</body>
</html>

```

upload.html

```

<html lang="en">

  <head>
    <title>Predict</title>
    <link href="https://cdn.bootcss.com/bootstrap/4.0.0/css/bootstrap.min.css" rel="stylesheet">
    <style>
      .bar { margin: 0px;
padding:20px; background-
color:white; opacity:0.6;
color:black; font-
family:'Roboto',sans-serif;
font-style: italic; border-
radius:20px; font-size:25px;
} a { color:red;
float:right; text-
decoration:none;
font-style:normal;
padding-right:20px;
} a:hover{
background-
color:black;
color:white; border-
radius:15px;0 font-
size:30px; padding-
left:10px;
} body
{ background-image: url("https://images.pexels.com/photos/1640777/pexels-
photo-
1640777.jpeg?cs=srgb&dl=pexels-ella-olsson-1640777.jpg&fm=jpg");    background-
size: cover;
} p {
color:white;
font-
style:italic;
font-size:30px;
} h1,h2

```

```
{ color:0101DF;
}
</style>
</head>

<body>

<div class="bar">
<a href="/pred">Predict</a>
<a href="/home">Home</a>
<br>
</div>
<div class="container">
  <center> <div id="content" style="margin-top:2em">
    <h2><center>Food Demand Forecasting</center></h2>
    <form action="{ { url_for('predict') } }" method="POST">

<select id="homepage_featured" name="homepage_featured">
<option value="">homepage_featured</option>
  <option value="0">No</option>
  <option value="1">Yes</option>

</select><br><br>
<select id="emailer_for_promotion" name="emailer_for_promotion">
<option value="">emailer_for_promotion</option>
  <option value="0">No</option>
  <option value="1">Yes</option>

</select><br><br>

  <input class="form-input" type="text" name="op_area" placeholder="Enter the op_area(2-7)"><br><br>
  <select id="cuisine" name="cuisine">
<option value="">Cuisine</option>
  <option value="0">Continental</option>
  <option value="1">Indian</option>
```

<option value="2">Italian</option>

<option value="3">Thai</option>

</select>

<select id="city_code" name="city_code">

<option value="">City Code</option>

<option value="590">590</option>

<option value="526">526</option>

<option value="638">638</option>

<option value="others">Others</option>

</select>

<select id="region_code" name="region_code">

<option value="">Region Code</option>

<option value="23">23</option>

<option value="34">34</option>

<option value="35">35</option>

<option value="56">56</option>

<option value="71">71</option>

<option value="77">77</option>

<option value="85">85</option>

<option value="93">93</option>

</select>

<select id="category" name="category">

<option value="">Category</option>

<option value="0">Beverages</option>

<option value="1">Biriyani</option>

<option value="2">Desert</option>

<option value="3">Extras</option>

<option value="4">Fish</option>

<option value="5">Other Snacks</option>

<option value="6">Pasta</option>

<option value="7">Pizza</option>

<option value="8">Rice Bowl</option>

<option value="9">Salad</option>

```

        <option value="10">Sandwich</option>
        <option value="11">Seafood</option>
        <option value="12">Soup</option>
        <option value="13">Starters</option>
    </select><br><br>

        <input type="submit" class="my-cta-button" value="Predict">
    </form>
</center>
<br>
<h1 class="predict">Number of orders: { { prediction_text } }</h1> </div>
</div>
</body>
</body>

```

app.py

```

# import the necessary packages
import pandas as pd
import numpy as np
import pickle
import os

from flask import Flask, request, render_template
app = Flask(__name__, template_folder="templates")

@app.route('/', methods=['GET'])
def index():
    return render_template('home.html')

@app.route('/home', methods=['GET'])
def about():
    return render_template('home.html')

@app.route('/pred', methods=['GET'])
def page():
    return render_template('upload.html')

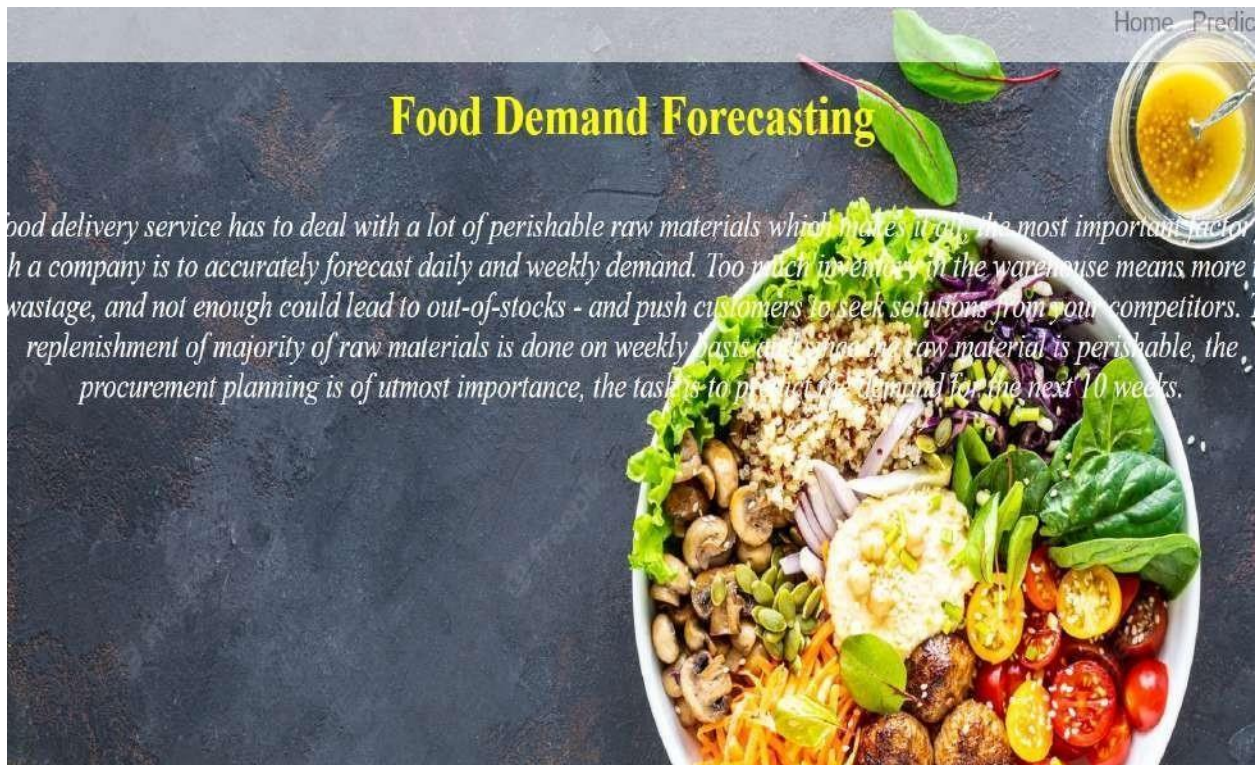
@app.route('/predict', methods=['GET', 'POST'])
def predict():
    print("[INFO] loading model...")
    model = pickle.load(open('demand.pkl', 'rb'))
    input_features =

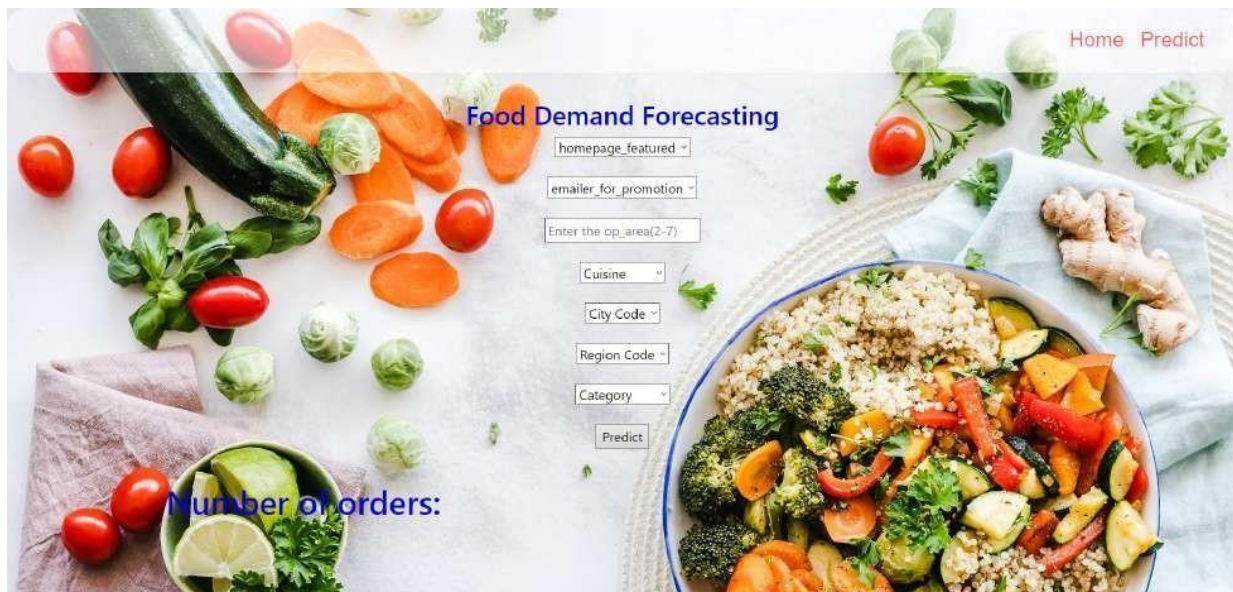
```

```
[float(x) for x in request.form.values())] features_value
= [np.array(input_features))] print(features_value)

features_name = ['homepage_featured', 'emailer_for_promotion', 'op_area', 'cuisine', 'city_code',
    'region_code', 'category'] prediction =
model.predict(features_value)
output=prediction[0] print(output)
return render_template('upload.html', prediction_text=output)

if __name__ == '__main__':
    app.run(debug=False) OUTPUT
SCREENSHOTS:
```





GITHUB LINK:

<https://github.com/IBM-EPBL/IBM-Project-33665-1660225124>

PROJECT DEMO LINK:

https://drive.google.com/drive/folders/1DUDtjg-ONGXv6-DiGzuOV04B_9OJMEig