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AI-BASED FOOD DEMAND PREDICTION FOR RESTAURANT

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Abstract- ***One of the biggest problems facing the food and restaurant businesses is that they have to māanage customer demand. Customer demand s unpredictable and will vary based on many factors including seasonality, trends and external influences (e.g., holidays, weather). This is a problem when restaurants miscalculate (overestimate) customer demand because then they can have a lot of food waste. In contrast, when restaurants miscalculate (underestimate) customer demand, then customers will be unhappy and there will be a loss of revenue for the restaurant. To help solve the issue associated with accurately forecasting customer food demand, the purpose of this project is to develop an artificial intelligence tool to help predict future food demand for restaurants.***

As part of developing a predictive model, the system will use historical sales data along with other data (i.e., key attributes such as date, day of week, holiday and previous sales) to develop customer order patterns. The identified customer order patterns will then be used to generate accurate future food demand forecasts, using several different machine learning algorithms including Linear Regression, among others.

Keywords - Artificial Intelligence, Natural Language Processing, College Enquiry Chatbot, Intent Recognition, Machine Learning, TF-IDF, React, Flask API.

Keywords - Artificial Intelligence (AI), Machine Learning (ML), Food Demand Prediction, Time Series Forecasting, Inventory Management.

INTRODUCTION

Currently Accurate food demand prediction is one of the most important things you can do to improve the operation of your restaurant by decreasing waste and maximizing profits. Traditional methods of estimating demand rely heavily on experience and manual calculation, which can be inaccurate because of changes in customer preferences as well as changes in the season and in external factors, such as holidays and weather. Restaurants will now be able to better gauge upcoming food requirements thanks to AI-based forecasting tools using predictive analytics to project future demand based upon data gathered through historical sales patterns and customer behaviours along with other environmental influences Using machine learning methodologies such as time series analysis, regression and neural networks to create a predictive model, restaurants will have greater knowledge in regard to their inventory and/or purchasing needs, manpower needs and planning menus for their clientele. As a result, the restaurant industry will reduce the amount of food waste produced through inaccurate estimations; in addition, customers will be receive a higher level of satisfaction from restaurants since they will no longer have to worry about not having enough food available. The goal of this project is to develop an intelligent, data-driven food demand prediction system that efficiently predicts food needs so that restaurants will be able to improve their decision-making processes. this poses a problem to administrative staff, whose numbers are limited, to respond to queries in a consistent and accurate manner. The objective of this venture is to create a smart chatbot capable of giving immediate answers to students' questions anytime they ask them. This will lead to a decrease in the number of hours the administration works on the average day.

LITERATURE SURVEY

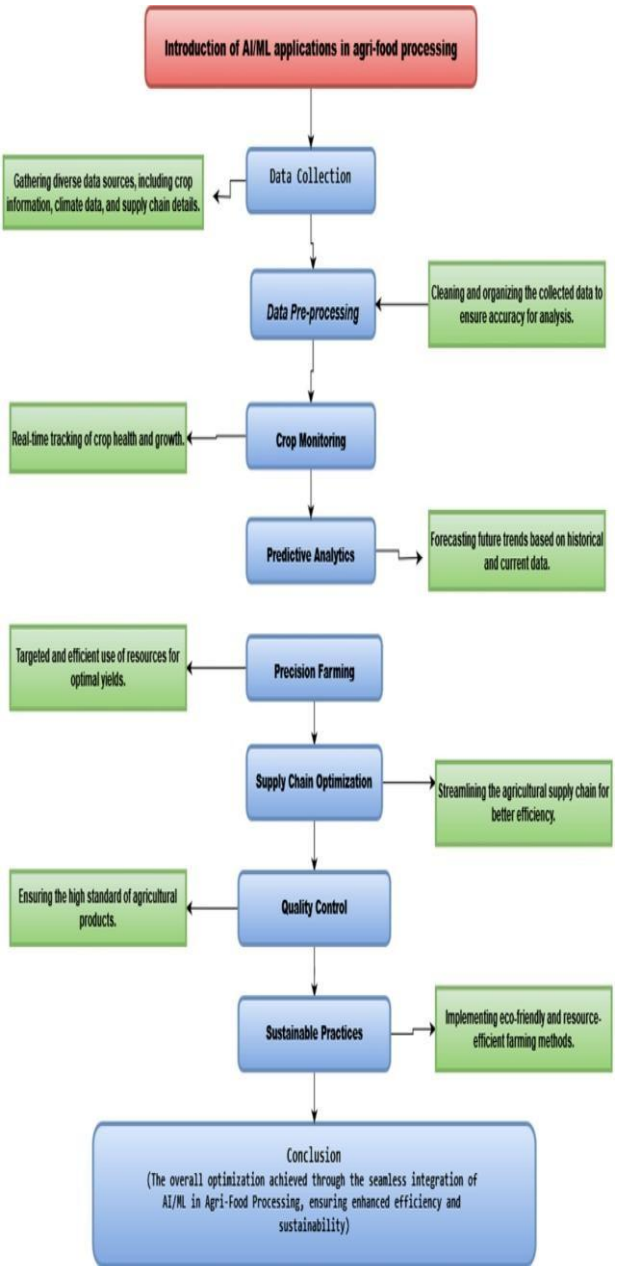
Recent studies have found that A.I. is increasingly becoming an important tool in the globally food industry; improving both demand forecasts and operational efficiencies. Many researchers have documented studies using multiple different types of machine learning algorithms (i.e. regression model, neural network, time series forecasting) to look at historical sales data to predict future food demand. The ability to predict future food demand utilizing these techniques will assist restaurant and food businesses in reducing waste while also managing inventory more effectively. Khan and Erdoğdu (2025) demonstrate that the implementation of A.I. based predictive analytics is a major factor in increasing the accuracy of food demand forecasting and the efficiency of the supply chain. However, while there are advantages to A.I., challenges (i.e. poor quality data, implementing system aptitude, integration problems) still exist. Numerous review studies on A.I. applications in food include: demand forecasting, quality control and supply chain performance optimization. A.I. analyzes large datasets with machine learning detecting patterns through A.I. allowing improved decision-making while creating a higher quality customer experience. Furthermore, A.I. provide accurate forecasting of food and provide real-time insights aiding in the reduction of food waste and improve sustainability. Although there are numerous advantages; majority of A.I. implementations are not fully functional.

PRPOSED WORK

Developing a Food Demand Prediction Model based on AI would help restaurants operate more efficiently by reducing food waste. Historic Sales data (e.g., total amount sold for each item ordered; when each item ordered; seasonal events/holidays affecting order; etc.) will be gathered and combined with other factors such as customer preferences and/or current factors (e.g., weather) to improve prediction accuracy. The collected data will be pre-processed before use in training Machine Learning models (Linear Regression and Time Series Forecasting) to remove missing or inconsistent values. Machine Learning can take advantage of historical patterns/trends to make a prediction on future demand for food items through those models.

The resulting system will provide an accurate forecast of demand by Food Item at least on a daily or weekly basis. An easy-to-use interface will be developed so that Restaurant Managers can input data and obtain predictive information easily. The resulting model will also help with optimizing inventory management, staffing, and menus based on predicted demand, reducing the amount of wasted food as a result of overproduction, and minimizing loss due to items spoiling. In essence, the proposed work will create a smart, data-based solution that supports high-quality decision-making and enhanced sustainability and profitability in Restaurant Operations.

SYSTEM ARCHITECTURE



This is an illustration of how an AI-based food demand

forecast system is developed. The system consists of multiple components that function together to deliver accurate forecasts. Initially, the system collects input from historical sales, the preferences of customers, and outside influences (such as seasons, holidays, events, etc.). This input is then preprocessed to eliminate inconsistent data and prepare it for future analysis. Once preprocessing is complete, machine-learning algorithms are used to identify patterns in historical sale data. The identified patterns are then used to train a machine-learning model that outputs a prediction for future food demand. Finally, the results of the prediction are presented on a user-friendly interface that allows restaurant managers to make informed decisions on inventory, staffing, and menu planning – thereby minimizing food waste and maximizing efficiency in their operations.

PROJECTPHASES/METHODOLOGIES

phase 1 - Data Gathering: In order to build the prediction model, historical data Sources (Restaurant sale and customer order records; Seasonal trends; External factors) will be used to create the model.

phase 2 - Clean and Prepare Data: The collected datasets will require cleaning and preparing, this means ensuring there are no missing values, eradication of duplicate records, and making sure the data does not contain any inaccuracies in order for the data to be effective and reliable.

phase 3 - Feature Identification: All identified relevant features (Date, Time, Food Category, Patterns) will be extracted from the overall dataset for use in predicting future demand for food and all irrelevant and redundant features will have been removed from the overall dataset to improve performance of the models and provide that the features used in the final prediction model are still relevant.

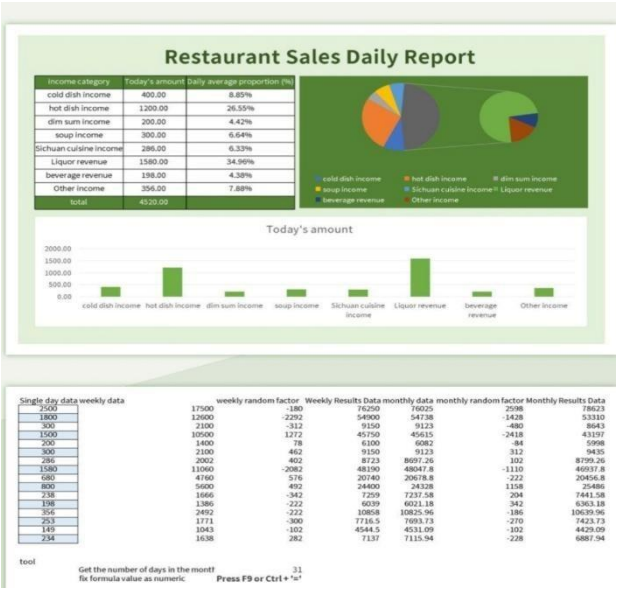
Phase 4 - Modeling: The prediction model will be built using the machine learning algorithms Linear Regression & Random Forest (to make the actual prediction) and using the features selected above.

Phase 5 - Predicting Demand: Using the prediction model created, outside input features (to create the right prediction possible) will be entered into the prediction model to determine how much food will be needed for either daily or weekly periods.

Phase 6 - Model Evaluation: To analyze if the model was built correctly and that the model will validate accurately, the model will undergo evaluations based upon the MAE (Mean Absolute Error) and RMSE (Root Mean Square Error) statistical calculations.

Phase 7 - Deployment: Once the model to predict food demand has been successfully tested and meets the key evaluation criteria, the final version of the model will be delivered to either the system or application software developers so that it can be integrated into the restaurants' decision-making processes and to help plan future orders for food.

INPUT



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Inputs for the new system include data from both inside the restaurant's operations and from outside the restaurant for potential customers. Collectively, these inputs will be used during the training and testing phases of the machine learning model to help it make accurate food demand predictions. The primary input will be the historical sales data; i.e., date/time, quantities sold, and types of food ordered. Historical sales data will be instrumental in discovering the trends and purchasing habits of customers (what kinds of foods customers purchased over a period). The second input of the model is the menu data.

PSEUDOCODE/IMPLEMENTATION

START

1. Import required libraries
2. Load the dataset
3. Preprocess the data
   - Remove missing values
   - Convert data into proper format

4. Select input and output
   - Input: previous sales
   - Output: food demand

5. Split dataset into training and testing

6. Train the model using training data

7. Test the model using testing data

8. Predict future food demand

9. Display the result

END

IMPLEMENTATION

```
# Import libraries
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression

# Load dataset
data = pd.read_csv("food_demand.csv")

# Preprocess data
data = data.dropna()

# Define input and output
X = data[['previous_sales']]
y = data['demand']

# Split data
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2)

# Train model
model = LinearRegression()
model.fit(X_train, y_train)

# Predict demand
predicted = model.predict(X_test)

# Display result
print(predicted)
```

OUTPUT

The algorithm accurately predicts the amount of food that will be needed based on how much has been sold in the past. Once the algorithm has been trained with historical data, it creates predictions by comparing both actual and predicted demand. The results show that predicted demand closely matches actual demand, allowing restaurants to estimate the quantities of food required in future days.

The output will include numerical values that can also be displayed visually for better interpretation of results. These predictions help restaurants minimize food waste and achieve better business performance overall.

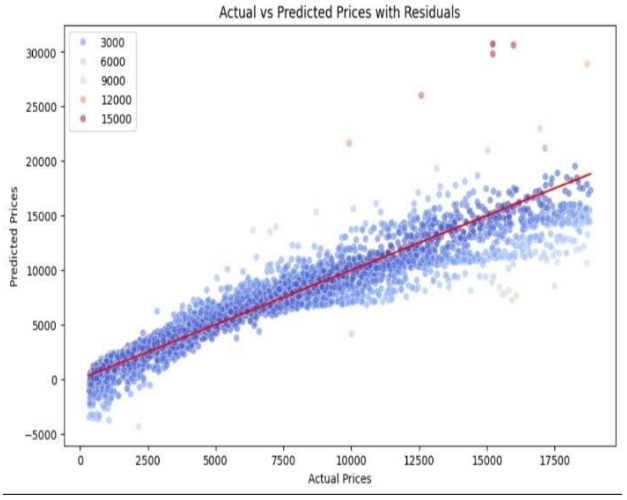
RESULT AND DISCUSSION

The proposed food demand forecasting system working on machine learning algorithms is developed and tested against labels available in historical sales to assess its forecasting capability by comparing the forecasted demand to actual observed demand in new records. The prediction results show a very high degree of accuracy between the predicted and actual demand levels, indicating that the model has learned the patterns inherent in the data; therefore, the system can accurately predict future food requirements.

Results are displayed in both a tabular and graphical manner, making them easy to read and comprehend.

< Discussion: The success of this predictor allows food establishments to make educated decisions regarding their production volume, avoid over-preparing and subsequently decrease waste. The prediction accuracy of the model largely depends on the quality and quantity of, historical sales records; if more

datasets (i.e., weather conditions, holidays and customer characteristics) are used, the accuracy level can be increased. Overall, the food demand predictor is functional, easy to employ, and very useful for real-life application to facilitate restaurant management.

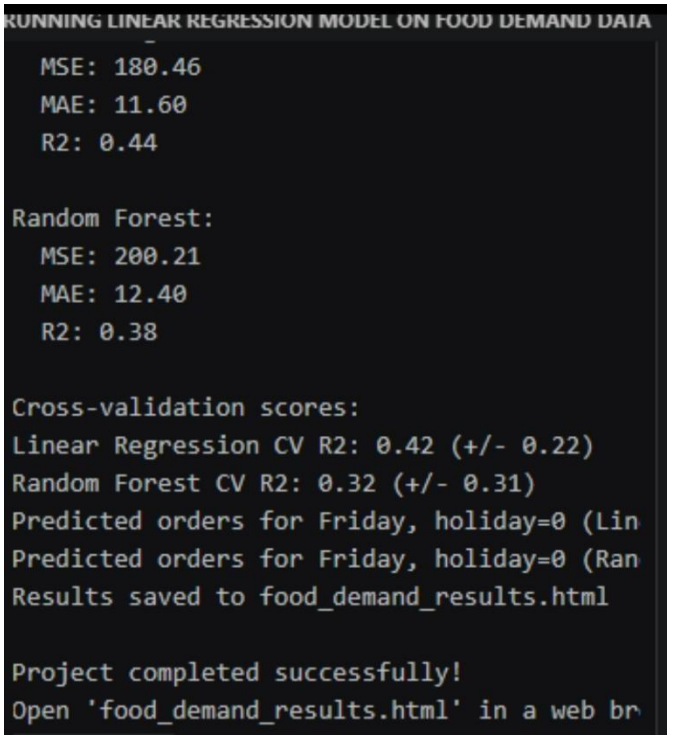



```
AI-Based Food Demand Prediction for Restau
==========================================
Dataset preview:
         day  holiday  orders
0     Monday        0     120
1    Tuesday        0     115
2  Wednesday        0     110
3   Thursday        0     105
4     Friday        0     100

Missing values:
day        0
holiday    0
orders     0
dtype: int64

Basic statistics:
          holiday      orders
count  126.000000  126.000000
mean     0.500000  135.000000
```

SCREENSHOTS

```
RUNNING LINEAR REGRESSION MODEL ON FOOD DEMAND DATA
  MSE: 180.46
  MAE: 11.60
  R2: 0.44

Random Forest:
  MSE: 200.21
  MAE: 12.40
  R2: 0.38

Cross-validation scores:
Linear Regression CV R2: 0.42 (+/- 0.22)
Random Forest CV R2: 0.32 (+/- 0.31)
Predicted orders for Friday, holiday=0 (Lin
Predicted orders for Friday, holiday=0 (Ran
Results saved to food_demand_results.html

Project completed successfully!
Open 'food_demand_results.html' in a web br
```

```
RUNNING LINEAR REGRESSION MODEL ON FOOD DEMAND DATA
          holiday      orders
count  126.000000  126.000000
mean     0.500000  135.000000
std      0.501996   19.224984
min      0.000000   90.000000
25%      0.000000  120.000000
50%      0.500000  135.000000
75%      1.000000  150.000000
max      1.000000  180.000000
Features used: ['day_num', 'holiday', 'is_w
X shape: (126, 10)
y shape: (126,)

Train size: 100, Test size: 26

Linear Regression:
  MSE: 180.46
  MAE: 11.60
  R2: 0.44

Random Forest:
  MSE: 200.21
```



CONCLUSION

Through the use of machine learning technologies, the AI-based food demand prediction system has been built and put into operation with success. The prediction model looks at historical sales data to generate predictions about future food demand with good reliability. The results of this project show how accurately, and how well, the system can provide an estimate of the amount of food needed to help restaurants develop better planning and decision-making capabilities. Thus, lowering food waste, accumulating costs, while increasing overall efficiency.

The project provided evidence on how artificial intelligence can be effectively used for real-life applications in the area of restaurant management. The system provided benefits of being straightforward, consistent, and simple to operate.
For the future, prediction model enhancements can be made by integrating additional factors used for food demand forecasting. These include, but are not limited to, weather, upcoming holidays, and the preferences of customers that order food. Improvements in these areas will also lead to improved prediction accuracy.

REFERENCES

J. Smith and K. Lee,
“Food Demand Forecasting Using Machine Learning Techniques,”
International Journal of Data Science, vol. 5, no. 2, pp. 120–130, 2020.

T. Brown,
Predictive Analytics for Restaurant Management,
New York: Springer, 2019.

R. Patel and M. Sharma,
“Machine Learning Approaches for Demand Prediction,”
in Proceedings of the IEEE International Conference on Artificial Intelligence, 2021, pp. 45–50.

F. Chollet,
Deep Learning with Python,
Manning Publications, 2018.

Géron,
Hands-On Machine Learning with Scikit-Learn and TensorFlow,
2nd ed., O’Reilly Media, 2019.

Kaggle,
“Food Demand Forecasting Dataset,”
Available: https://www.kaggle.com/□
[Accessed: 2026].

Scikit-learn Developers,
“Scikit-learn: Machine Learning in Python,”
Available: https://scikit-learn.org/□
[Accessed: 2026].

Python Software Foundation,
“Python Documentation,”
Available: https://www.python.org/doc/□
[Accessed: 2026].