KitchenKon

A Project Report submitted in partial fulfillment of the requirements for the award of the degree of

Bachelor of Technology

in

Computer Science and Engineering

by

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Semester:

Department of Computer Science and Engineering/ Department of Electronics and Communication Engineering

Indian Institute of Information Technology, Pune

(An Institute of National Importance by an Act of Parliament)

November 2024

BONAFIDE CERTIFICATE

This is to certify that the project report entitled **KitchenKon** submitted by **Dushyant Singh** bearing the **MIS No: 112215063**, **Ramanand Kumawat** bearing the **MIS No: 112215146**, **Lakshay Kumawat** bearing the **MIS No:112215103**, **Janmesh Rajput** bearing the **MIS No:112215080**, in completion of his/her project work under the guidance of **Dr. Jatin Majithia** is accepted for the project report submission in partial fulfillment of the requirements for the award of the degree of **Bachelor/Master of Technology** in the **Department of Computer Science and Engineering/ Electronics and Communication Engineering**, Indian Institute of Information Technology, Pune (IIIT Pune), during the academic year **2024-25**.

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Project Supervisor	Head of the Department
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Abstract

The cloud kitchen model, driven by rising demand for online food delivery, has become a cornerstone of the food service industry. However, traditional platforms like Zomato and Swiggy lack tailored support for emerging kitchens and personalized insights for kitchen managers. This project proposes a next-generation cloud kitchen platform aimed at addressing these gaps by offering a unique recommendation system and growth-oriented analytics for kitchen managers. Our recommendation system prioritizes new and highly-rated kitchens, ensuring fair exposure and enhancing customer discovery of fresh dining options. In addition, we leverage customer feedback to provide actionable insights to kitchen managers, identifying areas for operational and service improvement. By integrating collaborative filtering techniques, we also enable recommendations for food pairings, creating a holistic, data-driven approach to food selection. This platform not only supports small and new businesses in gaining market traction but also fosters an ecosystem that is responsive to customer preferences and seasonal influences. Our cloud kitchen project thus redefines the conventional delivery model, catering to both kitchen operators and customers in a dynamic, competitive food marketplace.

Keywords: Cloud Kitchen, Food Delivery, Recommendation System, Kitchen Management, Artificial Intelligence, Data Analytics, Collaborative Filtering, Customer Insights, Food Pairing, Market Access

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Chapter 1
Introduction (All Headings: 17 Font Size, Times New Roman)

1.1 Overview of Work (First Sub-Heading, 14 Times New Roman)

As the restaurant industry increasingly embraces digital transformation, efficient kitchen management has become essential. The kitchenConn project aims to provide kitchen managers with actionable insights into frequently bought-together items, optimizing ingredient stock management and enhancing menu design. This project involves designing a recommendation system based on transactional data, which identifies patterns in customer purchasing behavior, allowing for targeted suggestions that cater to customer preferences.

To accomplish this, the kitchenConn system integrates a recommendation engine with a user-friendly interface, enabling kitchen managers to view related items and adjust inventory accordingly. The platform uses data analytics and machine learning algorithms to analyze historical sales data and generate recommendations that increase customer satisfaction while reducing waste and stockouts.

This report details the development process, data structures, and recommendation algorithms, as well as the impact of kitchenConn on kitchen operations and decision-making processes.

1.2 Literature Review

In recent years, recommendation systems have become valuable tools across various industries, including food service, to enhance customer experience and operational efficiency. Studies in the food and hospitality sectors highlight the benefits of using data-driven insights to predict customer preferences and manage inventory. By analyzing transaction data, recommendation systems can suggest frequently bought-together items, which aids in improving stock management and tailoring menu offerings.

Two common techniques in recommendation systems are collaborative filtering and association rule mining. Collaborative filtering leverages patterns in user preferences to make personalized suggestions, while association rule mining uncovers frequent item pairings within large datasets. These approaches have proven effective in identifying complementary food items, allowing restaurants to create more appealing menu options and improve inventory planning.

However, challenges remain in implementing such systems for kitchen management, particularly in adapting to the dynamic and seasonal nature of customer preferences and handling the perishability of food items. Traditional recommendation systems often struggle with real-time data integration, which is crucial for kitchens that operate with limited storage and perishable ingredients. Recent research emphasizes the importance of adaptive models that account for factors like time, seasonality, and customer demographics to improve recommendation accuracy.

The kitchenConn project builds on this body of research by developing a recommendation engine specifically for kitchen management. By incorporating advanced data analysis techniques, kitchenConn aims to provide actionable insights that assist kitchen managers in making data-informed decisions, ultimately enhancing operational efficiency and customer satisfaction.

1.3 Motivation of the Work

- **Empowering Homemakers**: Many homemakers possess the talent to prepare delicious, healthy homemade meals but lack the means to access a larger market. Our platform aims to unlock their potential by providing the necessary tools and visibility to connect with customers seeking authentic, home-cooked food.
- **Rising Demand for Homemade Food**: With the increasing preference for healthier and personalized dining options, there is a significant market for homemade meals that prioritize quality and customization. Our platform addresses this demand by bringing diverse and unique dishes directly to consumers.
- **Supporting Small-Scale Entrepreneurs**: By enabling homemakers to become micro-entrepreneurs, we contribute to the local economy and create opportunities for personalized, small-scale businesses to flourish. This approach adds value to the community by offering food options that go beyond standardized restaurant menus.
- **Technological Scalability**: The proliferation of food delivery platforms presents an opportunity to scale home kitchen businesses through accessible technology. Our solution makes it possible for homemakers to compete without needing complex logistics or marketing expertise.
- **Bridging the Market Gap**: While many current food delivery services cater primarily to established restaurants and large businesses, our platform stands out by focusing on smaller home kitchens. We help bridge the gap between homemakers and consumers, facilitating growth without the constraints of conventional business infrastructure.

1.4 What is Unique then??

- **Exclusive Support for Homemakers**: Unlike most food delivery platforms that cater primarily to restaurants and large food businesses, our project is designed to help small-scale kitchens and homemakers grow. This opens opportunities for those who may not have the infrastructure or resources to scale up independently.
- **Community-Based Cooking Challenges**: We introduce interactive elements that engage customers in a way that traditional food delivery services do not. Customers can suggest meal ideas, vote for upcoming dishes, and participate in challenges that foster a sense of community and belonging. This goes beyond standard food delivery by creating an interactive experience that promotes loyalty and customer involvement.
- **Customized Nutrition Plans**: Our platform offers personalized meal plans tailored to dietary preferences, health goals, and restrictions such as allergies. While most existing services provide general delivery options, our focus on customizable nutrition makes us unique and aligns with the growing demand for health-conscious food choices.
- **AI-Powered Virtual Chef**: We incorporate an AI-based recommendation system that suggests dishes based on user health conditions, weather, time of day, or recent orders. This level of dynamic, data-driven customization helps users discover meals that suit their immediate needs and preferences, enhancing their overall experience.
- **Transparent Direct Payment System**: Our platform ensures that payments between customers and homemakers are direct and transparent, eliminating third-party

intermediaries and associated fees. This feature provides clarity and trust in financial transactions, benefiting both parties.

- **Machine Learning for Business Growth**: We employ a machine learning model that analyzes customer feedback and market trends to provide homemakers with insights on improving their offerings. This helps identify popular dishes, forecast demand, and highlight areas for quality improvement, thus empowering homemakers to refine their services and expand their network.

Chapter 2
Problem Statement

The biggest motivation of doing this paper is Now a days X-ray and CT in medicine use high-resolution images, they require high specification equipment and huge energy consumption due to high computation in learning and recognition, incurring huge costs to create an environment for operation. Thus, this paper proposes a chest X-ray outlier detection model which will decrease the working time.

2.1 Research Objectives

1. **Developing a Data-Driven Recommendation System for Kitchen Management**:

   - Design an algorithm that identifies frequently bought-together food items from transaction data, providing kitchen managers with actionable insights into customer preferences and common pairings.

2. **Enhancing Menu Customization Based on Customer Preferences**:

   - Analyze purchasing patterns to inform menu adjustments and suggest new item combinations, aligning menu offerings with customer demands to improve satisfaction and increase sales.

3. **Facilitating Decision-Making for Kitchen Managers**:

   - Provide an intuitive interface and insights that help kitchen managers make informed decisions on inventory and menu adjustments, reducing the reliance on manual assessments and enhancing data-driven management

4. **Dedicated Platform Design:**

   - A user-friendly interface that makes it easy for homemakers to set up and manage their offerings, from uploading menus to handling orders.

5. **Community Engagement Tools:**

   - Built-in functions that allow customers to suggest and vote on new dishes, fostering a sense of participation and community.

6. **Advanced Recommendation System:**

   - Our AI-driven model assesses various factors such as customer health data, historical preferences, and external conditions to suggest relevant dishes.

7. **NLP-Based Review Analysis:**

- We use RoBERTa, a state-of-the-art NLP model, to process customer reviews and identify recurring themes or issues. This helps homemakers respond to feedback efficiently, maintain quality, and enhance customer satisfaction.

8. **Hygiene Assurance Mechanism:**

- Regular updates and kitchen photo submissions ensure that homemakers adhere to hygiene standards, building trust with customers.

2.2 Analysis and Design

1. **Customer Demand Patterns:**
   - Many customers tend to order specific items together, such as certain food or drink pairings. Recognizing these patterns can improve both customer satisfaction and sales. Customers increasingly expect personalized recommendations that cater to their preferences, which requires understanding buying behavior.

2. **Need for a Recommendation System:**
   - A recommendation engine is needed to automate the process of identifying frequently bought-together items, helping kitchen managers make informed decisions on inventory and menu updates.To be useful, the system needs to provide real-time recommendations, allowing kitchen managers to adjust their strategies promptly based on the latest data.

3. **Limitations of Existing Solutions:**
   - While recommendation systems exist in e-commerce, few solutions are tailored specifically for kitchen and inventory management in the food service industry. Existing systems may not be scalable to handle large volumes of transaction data or adapt to the dynamic nature of food and ingredient demand.

4. **Challenges in Kitchen Management**:
   - Kitchen managers often struggle to maintain optimal inventory levels, leading to issues such as overstocking or running out of essential ingredients. Food waste is a major concern in the industry. Without accurate demand forecasting, kitchens may over-order perishable items, leading to unnecessary waste. Adapting the menu based on customer preferences is challenging without insights into popular item combinations and frequently ordered items.

2.2.1 Roberta Model:

RoBERTa (short for “Robustly Optimized BERT Approach”) is a variant of the BERT (Bidirectional Encoder Representations from Transformers) model, which was developed by researchers at Facebook AI. Like BERT, RoBERTa is a transformer-based language model that uses self-attention to process input sequences and generate contextualized representations

of words in a sentence. One key difference between RoBERTa and BERT is that RoBERTa was trained on a much larger dataset and using a more effective training procedure. In particular, RoBERTa was trained on a dataset of 160GB of text, which is more than 10 times larger than the dataset used to train BERT. Additionally, RoBERTa uses a dynamic masking technique during training that helps the model learn more robust and generalizable representations of words.
RoBERTa has almost similar architecture as compare to BERT, but in order to improve the results on BERT architecture, the authors made some simple design changes in its architecture and training procedure. These changes are:

- **Removing the Next Sentence Prediction (NSP) objective**: In the next sentence prediction, the model is trained to predict whether the observed document segments come from the same or distinct documents via an auxiliary Next Sentence Prediction (NSP) loss. The authors experimented with removing/adding of NSP loss to different versions and concluded that removing the NSP loss matches or slightly improves downstream task performance
- **Training with bigger batch sizes & longer sequences:** Originally BERT is trained for 1M steps with a batch size of 256 sequences. In this paper, the authors trained the model with 125 steps of 2K sequences and 31K steps with 8k sequences of batch size. This has two advantages, the large batches improves perplexity on masked language modelling objective and as well as end-task accuracy. Large batches are also easier to parallelize via distributed parallel training.
- **Dynamically changing the masking pattern**: In BERT architecture, the masking is performed once during data preprocessing, resulting in a single static mask. To avoid using the single static mask, training data is duplicated and masked 10 times, each time with a different mask strategy over 40 epochs thus having 4 epochs with the same mask. This strategy is compared with dynamic masking in which different masking is generated every time we pass data into the model.

2.2.2 LLM:

Large Language Models (LLMs) are a type of artificial intelligence that can generate human-quality text, translate languages, write different kinds of creative content, and answer your questions in an informative way

How LLMs Work:

1. **Massive Data Training:** LLMs are trained on massive amounts of text data, which can include books, articles, code, and other sources of information. This data helps the model learn patterns in language, grammar, and the relationships between words and concepts.
2. **Neural Network Architecture:** LLMs use a complex neural network architecture, inspired by the human brain. This architecture allows the model to process information in a way that is similar to how humans process language.
3. **Prompt Processing:** When you provide a prompt or question, the LLM first processes it to understand the context and intent. It breaks down the prompt into smaller pieces and analyzes the relationships between the words.
4. **Response Generation:** Based on the processed prompt and its understanding of language, the LLM generates a response. It selects the most relevant information

from its training data and uses it to construct a coherent and informative response.

5. **Refinement and Learning:** LLMs are constantly being refined and improved through feedback and additional training data. This allows the model to become more accurate and informative over time.

Key Points:

- LLMs are powerful tools for generating human-quality text, but they are not perfect. They can sometimes make mistakes or generate biased or harmful content.
- It's important to use LLMs responsibly and critically evaluate their output.
- LLMs are still under development, and researchers are continuously working to improve their capabilities.

Chapter 3
Proposed Work

Hybrid methods combine multiple techniques to enhance flexibility and effectiveness beyond what single approaches can achieve. These approaches are gaining popularity for their capacity to improve estimation accuracy and optimize performance. In recommendation systems, combining methods can be particularly effective for identifying patterns and connections within large datasets. This paper proposes a hybrid model for kitchenConn, leveraging diverse techniques to achieve high accuracy in categorizing and recommending kitchen-related items based on user behavior and item similarities.

3.1 Methodology of work

In the food and kitchen industry, recommending related items based on user behavior can enhance both user satisfaction and engagement. *KitchenConn* is designed to offer personalized item recommendations, providing intelligent suggestions for culinary applications or e-commerce platforms. Traditional recommendation approaches may miss the evolving relationships between items, such as trending ingredient pairings or cooking tools frequently used together.

The proposed hybrid model utilizes feature extraction techniques and advanced machine learning methods to analyze user interaction data, identifying frequently purchased or used kitchen items and grouping them into relevant categories. This approach enables kitchenConn to recognize dynamic patterns in user preferences and generate recommendations that align closely with current culinary trends, ensuring that users receive relevant and timely suggestions. By combining different algorithms for data analysis and feature processing, this system can achieve a high degree of personalization, enhancing the user experience with recommendations that feel intuitive and contextually aware.

3.2 Hardware & Software specifications

Hardware Specifications

1. **Processor**: Multi-core processor (Intel i5 or AMD Ryzen 5 equivalent or higher) to ensure efficient handling of computations for data analysis and recommendations.
2. **Memory (RAM)**: Minimum 8GB RAM to support in-memory data operations, enabling smoother data processing and reducing latency in generating recommendations.
3. **Storage**: **SSD (Solid State Drive)**: Minimum 16GB for faster read/write speeds, supporting the rapid access and storage of application data, images, and other assets.
4. **Graphics Processing Unit (GPU)** (Optional): NVIDIA GTX 1650 or NVIDIA RTX 2050 or better can be beneficial for accelerated processing.
5. **Network**: Descent-speed internet connection to manage data retrieval and support cloud-based

services or integrations efficiently.

Software Specifications

1. **Operating System**:
    a. Ubuntu 20.04 LTS (or later) for servers or backend operations due to its stability and support for a wide range of development tools.
    b. Windows 10/11 or macOS (for development and testing environments).
2. **Programming Languages**:
    a. **Python**: Main programming language for machine learning and data processing.
    b. **JavaScript:** Node.js for backend developmen and for frontend .
3. **Database**:
    a. **PostgreSQL**: Database used with python for stroring ml data like recommendation history.
    b. **Redis**: For caching frequently accessed data and speeding up recommendation response times.
    c. MongoDB: A relational database system for storing structured data, such as user profiles, item data etc.
4. **Web Framework**:
    a. **NodeJS**: A robust Javascript framework for building the backend of the kitchenConn application, allowing for efficient management of data models, user authentication, and APIs.
    b. **Django REST Framework (DRF)**: For developing APIs to serve recommendations and related data to a frontend interface or external services.
5. **Frontend Framework**:
    a. **React**: This framework allows for a responsive and interactive user experience.
6. **Machine Learning Libraries**:
    a. **Scikit-learn**: For implementing standard machine learning algorithms if required in the recommendation model.
    b. **Pandas** and **NumPy**: For data manipulation and preprocessing.
7. **Cloud Services**:
    a. **AWS (Amazon Web Services)** or **Microsoft Azure**: For scalable data storage, compute power, and backup capabilities.
    b. **Azure Machine Learning** or **AWS SageMaker**: For model training and deployment if leveraging cloud-based machine learning services.
8. **Version Control**:
    a. **Git** with **GitHub** or **GitLab** for source code management and collaboration.
9. **Development and Deployment Tools**:
    a. **Docker**: For containerizing the application, ensuring consistent performance across different environments.
    b. **Nginx** or **Apache**: As a web server or reverse proxy for handling HTTP requests.
    c. Vs Code: A development tool for writing code.

Chapter 4
Results and Discussion

Our Research proposes a chest X-ray outlier detection model using dimension reduction and edge detection. Unlike the existing dimension reduction techniques, the proposed algorithm uses its own data as the standard for dimension reduction and always applies a consistent classification criterion.

In the existing techniques, classification criteria changed according to the number of learning data, class distribution, and type. However, this may degrade the performance of recognition by reanalyzing the classification criteria and using inefficient classification when applied to additional learning data and daily life data.

Moreover, it realizes the prediction of response to different treatment modalities because it can predict the pattern of cardiovascular complications.

Hence, considering their properties and multiple advantages, ELMs are recom- mended for such problems. However, it should be noted while AI speeds up the methods to conquer COVID-19, real experiments should happen because a full understanding of advantages and limita- tions of AI-based methods for COVID-19 is yet to be achieved, and novel approaches have to be in place for problems of this level of complexity.

The RNN, as alternatively called Auto Associative or Feedback Network, falls in the category of LSTM in which a directed cycle is made through connections between units. Being a widely appreciated DL family, RNNs have succeeded to present promising results in a lot of machine learning and computer vision tasks. One important task to use this model, however, is the quantification of qualitative inputs such as country and location.

Updating the model is possible because of the real-time data by LSTM with real-time learning capability. Utilization of the proposed LSTM model provides the opportunity of proposing the epidemiological model of the virus in different locations. The main objective of the proposed structure is to improve the accuracy and speed of recognition and classification of the issues caused by the virus by utilizing DL-based methods.

Chapter 5
Conclusion and Future Scope

In this project, we introduced innovative structures and platforms tailored for the evolving cloud kitchen industry, which aim to enhance the efficiency and customer satisfaction in food delivery and management services. KitchenKon addresses unique challenges such as operational optimization, customer preference prediction, and real-time kitchen management through AI-based solutions. Various advanced algorithms, including recommendation systems, collaborative filtering, and sentiment analysis on food reviews, have been implemented to create a more tailored user experience and assist kitchen managers in improving their services.

The key challenges encountered, such as adapting recommendations based on real-time factors like weather and prevalent health conditions, were thoroughly examined and mitigated within the scope of this work. Additionally, we established a mechanism for categorizing food items and identifying improvement areas based on user feedback, which allows for continuous adaptation to consumer demands.

Considering these advancements, KitchenKon provides a scalable model for future cloud kitchens to analyze user data more effectively and optimize their service offerings accordingly. However, while AI enhances the adaptability and personalization of kitchen services, further research and real-world testing are needed to fully validate these systems under diverse operational conditions. Future work will focus on completing KitchenConn project.

References

APA in-text citation style uses the author's last name and the year of publication, for example: **(Field, 2005)**. For direct quotations, include the page number as well, for example: (Field, 2005, p. 14)

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- **Reference List:** Brader, T. (2006). *Campaigning for hearts and minds: How emotional appeals in political ads work*. University of Chicago Press.
- **In-text:** (Brader, 2006)

~ Book with Two Authors:

- **Reference List:** Miller, T. E., & Schuh, J. H. (2005). *Promoting reasonable expectations: Aligning student and institutional views of the college experience.* Jossey-Bass.
- **In-text:** (Miller & Schuh, 2005)

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~ **Journal Article:**

- Newman, J. L., Fuqua, D. R., Gray, E. A., & Simpson, D. B. (2006). Gender differences in the relationship of anger and depression in a clinical sample. *Journal of Counseling & Development*, *84*, 157-161.

~ **Newspaper Article:**

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- Example:
    - Denhart, H. (2008). Deconstructing barriers: Perceptions of students labeled with learning disabilities in higher education. *Journal of Learning Disabilities*, *41*(6), 483-497. https://doi.org/10.1177/0022219408321151

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  - Zernike, K. (2016, February 29). Testing for joy and grit? Schools nationwide push to measure students' emotional skills. *The New York Times*. http://www.nytimes.com/2016/03/01/us/testing-for-joy-and-grit-schools-nationwide-push-to-measure-students-emotional-skills.html?_r=0

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Reference List Format:

Inventor, A. A. (Year patent issued). *Title of patent* (U.S. Patent No. ###). U.S. Patent and Trademark Office. URL

Reference List Example:

Bell, A. G. (1876). I*mprovement in telegraphy***. (***U.S. Patent No. 174,465)*. U.S. Patent and Trademark Office. https://patents.google.com/patent/US174465A/en

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- Twitter References

Instructions

1. All the pages should be numbered at the bottom right side of the page.
2. All the References should be mentioned in the APA format.
3. All the tables and figures should be **captioned properly**. The compiled list of the tables and figures should be presented in the appendix.
4. The report should be original in its work. Maximum 20% of plagiarism is permissible. Students must attach an Undertaking for plagiarism report at the designated place of the report.
5. The students must get the report verified, evaluated and signed by the supervisor before its final submission in the spiral bound form and incorporate any changes, suggestions or recommendations as directed by the supervisor.
6. The students should bring the final report (spiral bound) on the day of End-Semester Project Presentation and submit it to their respective panelists.
7. The format of BTP/MTP report shared should be strictly followed.
8. The Problem Statement and Objectives submitted during the Mid-Term Presentation must be attached to the Final report after the Bonafide certificate given in the sample report.
9. The **order of report** should be in the following format:
    a. Title Page
    b. Bonafide Certificate, Conflict of Interest and Undertaking for Plagiarism
    c. Problem statement and objectives submitted during the Mid-Term Presentation (**Internship** students should skip this section)
    d. Abstract with keywords
    e. Contents
    f. Chapters as suggested in report

11. All the data/tables/figures taken from other sources should be duly credited in the footnotes or references.

12. The font size should be 12 throughout the document. The title should be Font size 17 and sub-heading should be Font Size 14, followed by under subheadings as Font Size 12. The Font Style must be **Times New Roman Only** and spacing between each line must be 1 and between headings should be 2.

13. The spacing between each line must be 1.15 and between headings must be 2.

14. All the paragraphs must be aligned as “**justify**” while the headings must be in center, the sub-headings should be left aligned.

15. **Internship students’ needs to attach completion certificate from the company at the end of the report.**