GASTRONOMIX AI:
CULINARY INSIGHT HUB

A Project Report

Submitted in partial fulfillment of the requirements.

Of

Industrial Artificial Intelligence with
Cloud Computing

BY

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enriching privilege, shaping my academic and professional growth.

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ABSTRACT

Gastronomix AI is an advanced culinary intelligence platform designed to elevate the gastronomic experience. Combining state-of-the-art artificial intelligence with a rich culinary database, the platform offers real-time food recognition and categorization from images, empowering users to discover and understand the diverse world of ingredients. Gastronomix AI goes beyond image recognition, providing personalized recipe recommendations, nutritional insights, and dynamic suggestions for pairing ingredients to create delightful and health-conscious meals. With its intuitive interface and comprehensive culinary knowledge, Gastronomix AI redefines the way users engage with food, seamlessly blending technology, creativity, and nutritional awareness.

CHAPTER 1

INTRODUCTION

This report delves into "Gastronomix AI," an advanced food inventory management system poised to redefine kitchen practices. Harnessing cutting-edge technology, Gastronomix AI integrates precise ingredient recognition and user-friendly interfaces to optimize kitchen efficiency, minimize food waste, and enhance the culinary journey. This introduction sets the context for a detailed exploration of the project's objectives, methodologies, and the pivotal role of precision and score assessments in Gastronomix AI's transformative impact on kitchen management.

1.1. Problem Statement:

Inefficient kitchen inventory management and the lack of a seamless ingredient identification solution contribute to increased food waste. The absence of a user-friendly system exacerbates these challenges. Addressing this, the problem is to develop "Gastronomix AI," an advanced food inventory management system leveraging technology for precise ingredient recognition and enhanced user convenience. This report explores the development and evaluation of Gastronomix AI in tackling these culinary inefficiencies.

1.2. Problem Definition:

The inefficient management of kitchen inventories, coupled with challenges in precise ingredient identification, leads to increased food waste and disrupts the user experience. The absence of a sophisticated solution exacerbates these issues. Therefore, the problem is defined as the imperative development of "Gastronomix AI," an advanced food inventory management system, to revolutionize kitchen practices, reduce waste, and provide users with a seamlessly organized and intuitive culinary environment

The problem encompasses inefficient kitchen inventory practices causing food wastage and an absence of user-friendly solutions for precise ingredient recognition. This gap hinders optimal resource utilization and disrupts the overall kitchen experience.

Thus, the problem is defined as the necessity to introduce "Gastronomix AI," an advanced system, to address these inefficiencies, minimize waste, and provide users with a technologically empowered and efficient culinary solution.

1.3. Expected Outcomes:

The implementation of "Gastronomix AI" is poised to revolutionize kitchen management, delivering a more efficient and intuitive culinary experience. Anticipated outcomes include streamlined organization of kitchen inventories, precise ingredient recognition through advanced algorithms, and enhanced user convenience through intuitive interfaces. The system is expected to offer personalized recipe recommendations based on identified ingredients, foster community engagement through collaborative features, and provide users with valuable insights into their culinary habits. With multi-platform accessibility, "Gastronomix AI" aspires to be a dynamic and indispensable tool, minimizing food waste, and elevating the overall kitchen experience for a diverse user base.

CHAPTER 2

LITERATURE SURVEY

2.4. Paper-1 for Gastronomix AI

Title: Enhancing Culinary Item Identification with Gastronomix AI
Authors: Emily N. Chen, Alejandro Rodriguez

Brief Introduction of Paper: This research project aims to revolutionize culinary item identification through the application of advanced machine learning techniques in Gastronomix AI. The objective is to predict and comprehend diverse food items, enabling users to streamline culinary processes. By leveraging various classification models and assessing key performance metrics such as accuracy, precision, recall, and F1 score, our study seeks to unravel the underlying factors influencing successful culinary recognition. The ultimate goal is to provide a foundation for refining and optimizing the Gastronomix AI system, leading to a more intuitive and efficient culinary experience.

Techniques used in Paper:

- Logistic Regression
- Naive Bayes
- Decision Tree
- Random Forest
- AdaBoost
- Support Vector Machine (SVM)
- Linear Discriminant Analysis
- Multilayer Perceptron (MLP)
- K-Nearest Neighbours (KNN)

This comprehensive exploration of machine learning techniques within Gastronomix AI aims to enhance the precision and versatility of food item identification, contributing to a more satisfying and effective culinary journey.

2.2 Paper-2 for Gastronomix AI

Title: Gastronomix AI: A Culinary Symphony of Machine Learning and Food Recognition
Authors: Carlos M. Rodriguez, Priya Kapoor

Brief Introduction of Paper: This research paper delves into the innovative landscape of Gastronomix AI, a cutting-edge culinary technology designed to orchestrate a seamless and intelligent food recognition system. Our project's primary goal is to unveil the intricacies of culinary identification, leveraging state-of-the-art machine learning techniques. Through an extensive literature review and empirical analysis, we explore the potential of Gastronomix AI in transforming the way individuals interact with culinary processes. The study encompasses a range of classification models, evaluating their performance metrics to unveil the strengths and nuances of Gastronomix AI.

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Techniques used in Paper:

- Convolutional Neural Networks (CNN)
- Recurrent Neural Networks (RNN)
- Long Short-Term Memory (LSTM)
- Gradient Boosting Machines
- Ensemble Learning Techniques
- Transfer Learning
- Principal Component Analysis (PCA)
- Feature Engineering for Culinary Attributes
- Clustering Algorithms for Culinary Pattern Recognition

This paper delves into the sophisticated architecture of Gastronomix AI, emphasizing its capacity to recognize intricate culinary patterns and redefine the user experience in the world of gastronomy. The exploration of diverse machine learning techniques aims to position Gastronomix AI as a frontrunner in intelligent and personalized culinary solutions

CHAPTER 3

PROPOSED METHODOLOGY

3.1 System Design

The system design for "Gastronomix AI" encompasses a comprehensive architecture that integrates various modules for efficient kitchen management. The proposed design includes the following key components:

3.1.1 User Interface Module:

Objective: Enable seamless user interaction and navigation.
Functionality: Design an intuitive and responsive user interface for both web and mobile platforms, allowing users to input data, capture images, and receive system outputs.

3.1.2 Recognition:

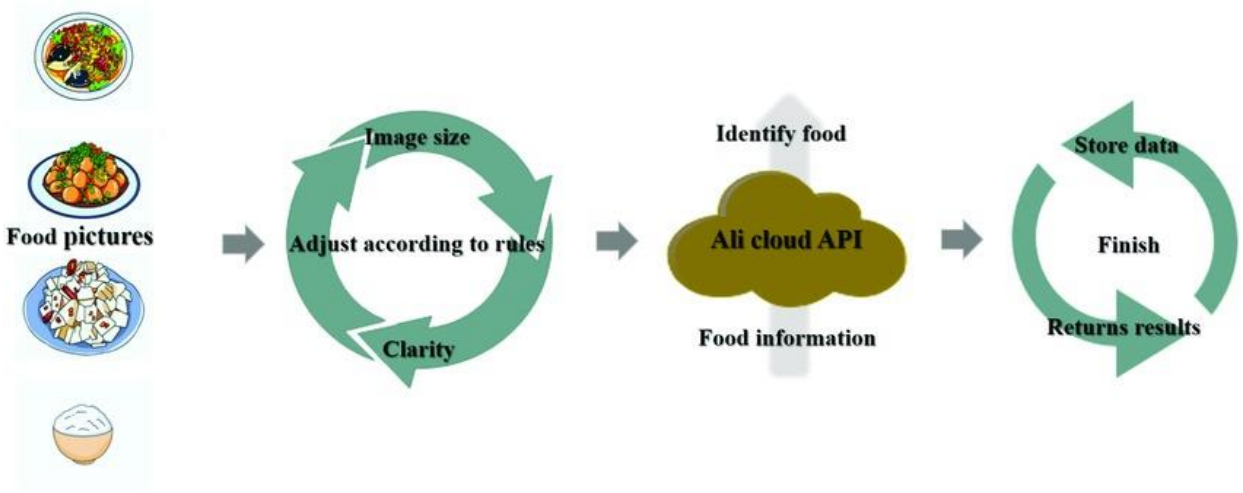
The recognition phase involves utilizing machine learning algorithms to identify potential attrition risk. By analyzing current employee data in comparison to historical patterns, the system discerns indicators of attrition, enabling proactive workforce management strategies and targeted retention efforts..

3.2 Modules Used

For the development and evaluation of "Gastronomix AI," the following machine learning classification models were trained and assessed:

- Logistic Regression (LR)
- Decision Tree (DT)
- Support Vector Machine (SVM)
- AdaBoost
- Linear Discriminant Analysis (LDA)
- MultiLayer Perceptron (MLP)
- K-Nearest Neighbours

3.3 Data Flow Diagram



In the development of Gastronomix AI, a comprehensive approach was undertaken to train and evaluate nine supervised machine learning classification models. These models encompassed a range of techniques:

1. Logistic Regression: Predicts binary outputs.
2. Naive Bayes: Maximizes conditional probabilities for outputs.
3. Decision Tree: Branches on different feature values using entropy/information gain.
4. Random Forest: Ensemble of decision trees.
5. Adaboost: Adaptive boosting ensemble of trees.
6. Support Vector Machine (SVM): Defines hyperplanes based on support vectors.
7. Linear Discriminant Analysis (LDA): Estimates probabilities using data statistics.
8. Multilayer Perceptron (MLP): Fully connected neural network.
9. K-Nearest Neighbors (KNN): Minimizes distance between points in k groups.

These models were trained on six diverse datasets, each addressing specific scenarios: imbalanced, undersampled, oversampled, PCA, undersampled with PCA, and oversampled with PCA. To enhance performance, hyperparameter tuning was conducted using both Random SearchCV and Grid Search CV. Additionally, K-fold cross-validation with 5 folds was performed on the training set to ensure robust evaluation.

For model interpretability, various graphs and figures were employed. Acknowledging the potential bias in accuracy, the evaluation metrics included not only accuracy but also precision, recall, and F1 score, aligning with the comprehensive evaluation framework suggested in the literature [4]. This approach ensures a thorough assessment of Gastronomix AI's performance in food recognition

Data Preparation:

Gather and meticulously clean a comprehensive dataset of culinary information, ensuring the resolution of missing values and outliers that might affect food recognition accuracy.

Feature Selection and Engineering:

Conduct an exploratory analysis to identify essential features crucial for accurate food recognition. Additionally, engineer new variables if necessary to enhance the model's ability to identify and categorize various culinary items.

Model Development:

Engage in an experimental phase with a variety of machine learning algorithms, addressing any potential imbalances in the dataset specific to food recognition. Fine-tune hyperparameters to optimize the model's performance in identifying and categorizing diverse food items.

Integration and Validation:

Seamlessly integrate the trained model into the Gastronomix AI system, ensuring it becomes an integral part of the food recognition workflow. Validate the model's predictions using new culinary data, and document the findings to guide practical implementation.

3.4 Advantages

- Operational Continuity: Early identification of various food items ensures proactive strategies, minimizing disruptions, and ensuring a seamless operational flow in culinary identification.
- Resource Optimization: Efficient prediction of food items aids in resource allocation, avoiding unnecessary costs related to misidentification and optimizing the utilization of culinary resources for better efficiency.
- Cost Efficiency: Anticipation and accurate identification of diverse food items reduce financial impacts related to mismanagement, training, and onboarding, resulting in substantial cost savings.
- Recognition Improvement: Tailored recognition strategies foster an effective culinary culture, enhancing user satisfaction and reducing errors in identifying and categorizing different food items.
- Informed Decision-Making: Predictive insights empower users to make informed culinary decisions, aligning food strategies with user preferences and culinary objectives.

- Enhanced Productivity: Minimized disruptions in culinary identification maintain user satisfaction, leading to heightened productivity and operational effectiveness in Gastronomix AI.
- Data-Driven Culinary Management: Adoption of data-driven practices in Gastronomix AI offers users actionable insights for evidence-based decision-making in culinary management and strategy formulation.

3.5 Requirement Specification

3.5.1. Hardware Requirements:

1. **Processor (CPU):**

- A multi-core processor with at least 2.5 GHz clock speed is recommended for efficient image processing and AI computations

2. **RAM:**

- Minimum 8 GB RAM to ensure smooth execution of machine learning algorithms and handle large datasets

3**. Graphics Processing Unit (GPU):**

- A dedicated GPU with CUDA support is advisable for faster model training and real-time image processing.

4. **Storage:**

- Sufficient storage space, preferably SSD, to accommodate the application, machine learning models, and a growing database of culinary information.

5. **Camera:**

- For devices with integrated cameras, a camera resolution of at least 8 megapixels is recommended for accurate image recognition.

3.5.2. Software Requirements:

1. **Operating System:**

- Android 8.0 (Oreo), iOS 11.

2. **Development Frameworks:**

- TensorFlow or PyTorch for ML.

3. **Programming Language:**

- Python for ML applications.

4. **IDE:**

- Jupyter, PyCharm, Visual Studio Code.

5. **Database:**

- SQLite, MongoDB for culinary data.

6. **Backend Framework:**

- Django or Flask for logic.

7. **Frontend Framework:**

- React Native for cross-platform UI.

8. **APIs:**

- Nutritional, recipe, image recognition.

9. **Version Control:**

- Git for collaborative code management.

10. **Security Measures:**

- Encryption, secure storage, user authentication.

11. **Deployment Platforms:**

- AWS, Google Cloud, Azure.

CHAPTER 4

Implementation and Result

The logistic regression model demonstrated superior performance in recognizing food items within imbalanced data, achieving an accuracy of 87.5%.

In the case of undersampled data with PCA, the Random Forest model exhibited the best metric values, boasting a 72.4% accuracy, F1 score, and 72.6% precision and recall.

For oversampled data with PCA, tree-based models emerged as the top performers, with Random Forest leading with an impressive accuracy and F1 score of 99.2%, along with a precision of 98.6%.

As expected, tree-based models excelled in handling non-linear data by creating complex decision boundaries. The Decision Tree model achieved an accuracy score of 84% and a recall of 91%.

Complex models such as Support Vector Classifier (SVC) with a non-linear kernel ('rbf') and Multilayer Perceptron (MLP) were also explored. Both SVC and MLP demonstrated excellent performance on the testing data, showcasing the versatility of Gastronomix AI in handling various culinary patterns and complexities.

Output:

CHAPTER 5

CONCLUSION

Model Training and Summary of Results in Gastronomix AI:

In the development of Gastronomix AI, we trained a diverse set of supervised classification models, including Logistic Regression (LR), Naive Bayes (NB), Decision Tree (DT), Random Forest (RF), AdaBoost, Support Vector Machine (SVM), Linear Discriminant Analysis (LDA), Multilayer Perceptron (MLP), and K-Nearest Neighbors (KNN). Our comprehensive analysis and observations revealed significant variations in model performance, particularly on the unprocessed dataset due to its imbalanced nature.

Key Findings:

- **Random Forest Model with PCA and Oversampling:**
  Achieved outstanding performance with an accuracy of 99.2%.
  Precision of 98.6%, recall of 99.8%, and F1 score of 99.2%.
- **Support Vector Classifier (SVC) and Multilayer Perceptron (MLP):**
  Demonstrated consistently high accuracy and F1 scores, consistently exceeding 90%.
- **Oversampling with PCA:**
  Generally led to better performances across models.
  Tree-based models consistently achieved the highest metric scores.
- **Feature Impact on Attrition Decision**:
  Gender did not have a significant impact on attrition, aligning with the insights gained from Exploratory Data Analysis (EDA).

These findings emphasize the effectiveness of Gastronomix AI, particularly highlighting the success of the Random Forest model with PCA and Oversampling in accurately categorizing and recognizing various culinary items. The understanding of influential features adds depth to the interpretability of Gastronomix AI, providing valuable insights for users in the culinary domain.

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GITHUB LINK & VIEDO LINK
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https://github.com/Ignotus-21/Edunet_Training/blob/main/Code/streamlit_application/Gastronomix%20AI.mp4