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ORIGINAL

Wisenosh Quantum AI: Nutritional Information Integrated With Image API and Nano Robotic System in Chemical Industries

Inteligencia artificial cuántica Wisenosh: información nutricional integrada con API de imágenes y un sistema nanorobótico en industrias químicas

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ABSTRACT

The Wisenosh Quantum AI platform offers a complete and smart nutrition analysis solution that combines food recognition through images, machine learning, and monitoring at the nanoscale level for making personalized dietary management easier. Deep learning models like ResNet-50 and EfficientNet are utilized in a way that the machine is able to recognize the dishes in the images uploaded by users, and at the same time, connect the serving size and nutrients to a secure RESTful API for exact nutrient research. The evaluation includes not only calories but also macronutrients, micronutrients, and vitamins, while Named Entity Recognition brings to light allergens and potential dietary issues. Individual recommendations are generated through collaborative filtering which considers users' likes, habits, and even their changing health goals. The combination of robot-assisted data collection, nanomaterial-based biological feedback, and chemical analysis of food components allows the system to provide very timely and contextually appropriate dietary guidance.AI, robotics, and quantum-inspired computing team up in ways that let them monitor processes closely and tweak them for better results. They handle important jobs like keeping food consumption safe and managing chemical operations, not to mention their work in industrial setups. That kind of collaboration adds a sharp level of accuracy to all these areas, which in turn boosts how well they run and how trustworthy they feel. The technologies lean on one another to pull off some really impressive achievements in a wide range of uses.Wisenosh Quantum AI is the pioneer of intelligent nutrition and health-controlled industrial processes going from the past to the future.

Keywords: Wisenosh Quantum AI; Nutritional Analysis; Food Recognition; Deep Learning; Nanomaterial Sensors; Personalized Nutrition; Food Chemical Processing; Robotic Monitoring.

RESUMEN

La plataforma de IA Cuántica Wisenosh ofrece una solución completa e inteligente para el análisis nutricional que combina el reconocimiento de alimentos mediante imágenes, el aprendizaje

automático y la monitorización a escala nanométrica para facilitar la gestión dietética personalizada. Se utilizan modelos de aprendizaje profundo como ResNet-50 y EfficientNet, lo que permite a la máquina reconocer los platos en las imágenes subidas por los usuarios y, al mismo tiempo, conectar el tamaño de la porción y los nutrientes a una API RESTful segura para una investigación nutricional precisa. La evaluación incluye no solo calorías, sino también macronutrientes, micronutrientes y vitaminas, mientras que el Reconocimiento de Entidades Nombradas (NONE) detecta alérgenos y posibles problemas dietéticos. Las recomendaciones individuales se generan mediante un filtrado colaborativo que tiene en cuenta los gustos, hábitos e incluso la evolución de los objetivos de salud de los usuarios. La combinación de la recopilación de datos asistida por robots, la retroalimentación biológica basada en nanomateriales y el análisis químico de los componentes de los alimentos permite al sistema proporcionar una guía dietética muy oportuna y contextualizada. La IA, la robótica y la computación cuántica se unen para monitorizar de cerca los procesos y optimizarlos para obtener mejores resultados. Se encargan de tareas importantes, como garantizar la seguridad en el consumo de alimentos y gestionar operaciones químicas, sin mencionar su trabajo en instalaciones industriales. Este tipo de colaboración aporta un alto nivel de precisión a todas estas áreas, lo que a su vez mejora su rendimiento y la confianza que generan. Las tecnologías se complementan para lograr logros realmente impresionantes en una amplia gama de usos. Wisenosh Quantum AI es pionera en nutrición inteligente y procesos industriales controlados para la salud, que van del pasado al futuro.

Palabras clave: Wisenosh Quantum AI; Análisis Nutricional; Reconocimiento de Alimentos; Aprendizaje Profundo; Sensores de Nanomateriales; Nutrición Personalizada; Procesamiento Químico de Alimentos; Monitoreo Robótico.

INTRODUCTION

Wisenosh Quantum AI isn't just another nutrition management tool—it's changing the way we look at food and nutrition. By blending smart computer systems with tiny biological sensors, it offers a super personalized way to track what you eat. You just snap a photo of your meal, and the system figures out what's on your plate, right down to the ingredients. This isn't just about recognizing foods visually; it's about digging deep into the nutritional details, even for complicated dishes.[1,2,3]

At its core, Wisenosh Quantum AI uses deep learning models like ResNet-50 and EfficientNet. These models can spot subtle differences in color, texture, and how foods are presented, so they're incredibly accurate when classifying what you eat. The system learns from a huge library of food images, picking up patterns to deliver solid nutritional analysis and tailored recommendations.[4]

Once it's identified your food, the system gives you the full nutritional breakdown—calories, macros, vitamins, minerals, the whole deal. You can access this info securely through a RESTful API, whether you're on your phone, your laptop, or syncing with other health apps. Everything stays private and secure. Plus, the API design makes it easy to connect with mobile apps, web platforms, or health monitoring systems, so it actually fits into your daily life.[5,6]

Safety and custom guidance are front and center. The system uses Named Entity Recognition (NER) to scan ingredient lists for allergens or anything that clashes with your dietary needs. If there's a problem, you get an alert right away—huge for anyone dealing with allergies or chronic health issues.[7]

Wisenosh Quantum AI keeps learning about you. It uses collaborative filtering—taking input from multiple sources—to fine-tune its suggestions. Over time, it adapts to your eating habits, preferences, and history, adjusting recommendations to help you hit your health goals. This kind of

ongoing personalization makes it easier to stick with good habits and long-term nutrition plans.[8]

What really sets this platform apart is its use of real-time physiological feedback. With nanomaterial-based sensors monitoring things like blood glucose or other metabolic signals, the system can tweak its advice based on your current state. It's a smart mix of digital and biological data, making dietary guidance feel a lot more intelligent.[9]

Wisenosh Quantum AI isn't just for personal use, either. It's also a powerful tool in food plants and industrial settings. With AI and robotics tracking everything and analyzing food chemistry, production, quality control, and safety checks get a lot simpler. Whether you're managing your own health or running a large-scale food facility, Wisenosh Quantum AI brings smart, quantum-inspired solutions to the table, optimizing everything from the ground up.[10]

Related Work

Current developments in food representations and nutrient assessment have successfully evolved with the addition of artificial intelligence (AI) and machine learning. NutrifyAI is an example of AI supporting high-quality dietary behaviors, according to Aguilar et al.[1] through real time food identification and personalized meal suggestions. Ye et al.[2] published a review Deep Learning for Food Image Recognition and Nutrition Analysis that highlights the value of accurately capturing dietary diary tracking for health management and the implementation of deep learning techniques for food image analytics beneficial for chronic disease management.

The availability of datasets and recommended benchmarks in Leveraging Automatic Personalized Nutrition Min et al.[3] provides a wholesomeness that allows scientists to apply models regarding the precise image detection of food, and researchers can support the design of improved algorithms that do not merely recognize general food categories. A real-time food detection example using YOLOv8s Ran et al.[4] showed a wider application of how CNN can indeed help contribute to applied work as well as the potential for applied diet work in timely simultaneous communication about food choices.

Evidence regarding the efficacy of deep learning in food image classification has come from research on Pattern Recognition based on Convolutional Neural Network for Food Image Classification, and Food Image Classification with Deep Features. Peer-reviewed studies [5,6], confirmed that these models can attain accurate classification on a wide variety of datasets. Users can measure their food in a more comprehensive way, including total caloric content, recommendations per day, and macronutrient breakdowns, by providing food-specific APIs like that of Edamam. Having this information available is valuable to users who are in control of their intake.[1]

Fine-grained recognition studies examining the Fine-Grained Recognition of Chinese Food Image Using DenseNet with Attention Mechanism provide evidence that custom (and deployed) models for food recognition systems are worthwhile, and made food classification system even more accurate where food was culturally specific.[4] Another advantage to food recognition and analysis for diet evaluation that could be utilized from Mask R-CNN disparities in nutritional data relating to easy scanning and analysis of meals on mobile devices is potential accessibility to nutritional insights.[2]

NutriNet compared the use of user friendly apps for making changes to eating behaviours to an example of how deep learning could be used to assess diet. State-of-the-art image recognition technology was employed to give users a prompt feedback mechanism on the selection of food and the taking up of healthier eating habits. One of the recent breakthroughs in the mentioned technology was the combination of uncertainty-based methods and multi-task learning models, which resulted in a more detailed interpretation of food analysis and preciseness of dietary assessment.[1]

AI is being increasingly utilized to ensure food safety, and the AI systems can be one of the most

efficient instruments in this aspect, even if they are operated by people who are not accustomed to using technology, for instance, Jubayer et al.[7] who also employed YOLOv5, an advanced object detection model, for the purpose of identifying food surfaces covered with mold so that the user can be alerted beforehand when the decay process takes place.

METHOD

Almost impossible is the phrase that comes into mind when trying to comprehend how WiseNosh works yet it uses AI and other data-centric methods to identify the food items and provide their nutritional value in the blink of an eye. To be more precise, several sophisticated machine learning models integrated with deep learning-based image processing are at work here, so that a simple picture can help them figure out what you are eating. Besides, it is not a single unit; Nutrition databases several (public and private) sources are queried in real-time for the detailed information on calories, macros, and micronutrients. Surely, the most significant part of all this technological wizardry is the photos' quality and how complete the databases are, as well as the moment when it functions, it is like having a smart nutritionist by your side, but in your pocket. The WiseNosh method is designed and equipped with software that makes it a fully automated and smooth single process, starting from food image recognition to delivering the user's dietary guidance.

Image Recognition Using CNN and Object Detection

The pipeline for image recognition, which aims to gather the characteristics of food images, involves convolutional neural networks (CNNs) as the underlying technology. CNNs essentially create multilevel representations/features of the images starting from the raw pixel data by the use of numerous layers of convolutional filters. Mathematically, a CNN on input image I generates a feature map F as shown below:

$$F=\sigma(W * I+b)$$

Where W -learned weights, * - convolution operation, b is the bias and σ - activation function (usually ReLU). In order to deal with images of meals that contain several items, WiseNosh might implement Region-based CNNs (R-CNN) which can locate and separate objects by creating region proposals with Selective Search, and then, classifying each extracted region.

One of the most important evaluation metrics for detection is the Intersection over Union (IoU):

$$IOU=(\text{Area of Union})/(\text{Area of Overlap})$$

Only regions greater than a set IoU threshold value (i.e. set at 0,5) will be selected and included for classification to ensure accurate multi-item food identifying.

Nanorobotic Biosensing for Physiological Monitoring

WiseNosh further combines nanomaterials with micro-robotic sensors, which can track specific physiological signals of the body for the purpose of digital food analysis. The graphene-gold nanoparticles-vs multistructured carbon nanotube(s)-based nanoscale biosensor have been implemented for continuous monitoring of glucose, lipids, and hydration levels. Consequently, these nanorobots deliver the vital signs over the IoT network to the AI platform of WiseNosh without any security concerns. This circuit of data provides the processor with the ability to connect an instant physiological reaction to the intake of food, thus, allowing a more efficient health management through the aid of a precision index.

Nutritional Analysis via API Integration

After the food items are recognized, the system makes API calls to the Nutritionix and the USDA Food Database to obtain nutritional values. For every food item f_i,the system will map to a nutritional profile vector N_i =[calories,protein,fat,carbs,...]. The total nutritional values for a meal with N keywords will be calculated as:

$$N_{total}=\Sigma_{i=1}^{n} p_i.N_i$$

Where p_i is the portion size multiplier for item i. This dynamic recalculation based on the current portion size will allow for precise caloric and nutrient tracking.

Allergen Detection Using Named Entity Recognition (NER)

The NER module executes a sequence tagging algorithm (usually, a BiLSTM-CRF model) to identify allergen-related entities in ingredient lists. A Bidirectional-LSTM embeds and processes every word/token in the ingredient description:

$$h_t=BiLSTM(x_t)$$

The final output of the CRF layer is a predicted set of entity tags (e.g., ALLERGEN=gluten), If any detected allergens match the user's allergy profile A= $\{a_1, a_2, a_3,...a_k\}$, an alert will be raised.

WiseNosh is a representative of the future society-based technology. It is an intelligent AI-driven food data management solution that, through a simple RESTful API, can significantly ease the whole process. The web-based applications and mobile apps can easily integrate with it. The two fundamental aspects underlying the core features of WiseNosh, namely (1) image recognition and (2) nutritional analysis, have been united to deliver accurate food identification along with reliable nutritional data of highquality. One of the components of Image Recognition technology exploits modern computer-vision technologies such as Convolutional Neural Networks (CNNs) and object recognition algorithms (e.g., R-CNN) to handle the analysis of food pictures and to find the most probable food ideas when food pictures are uploaded via the API. Figure 1 illustrates a complex dinner with multiple components, in this case, the module operates by dividing the input image and identifying the food components individually. Recognition is improved further by allowing the use of external databases that contain variously and extensively tagged pictures of the food items that provide an unmatched level of identification performance research over the different cuisines. After food identification, Nutritional Analysis is a module that fetches detailed nutrition information from different sources like Nutritionix API and USDA Food Database giving complete information on both macro and micro-ingredients like calories, carbohydrates, proteins, fats, vitamins, and minerals. The cutting-edge and smart technology offers the customer the opportunity to change the amounts to the actual use and the nutrition numbers will be recalculated by the system automatically. Also, the Named Entity Recognition (NER) module will be great support for you in getting the data you need from the processed ingredients, and additives and preservatives - coming from the packaged foods.

WiseNosh keeps on improving the user experience and provides real-time useful information about some dangerous foods to users with the help of the Allergen Detection module, which identifies allergens in food ingredients, such as gluten, dairy, nuts, and soy. The Personalized Meal Recommendation system enables users to employ Collaborative Filtering (CF) for learning personal health preferences and consumption habits and therefore, making healthier and more appropriate meal recommendations. Our AI meal recommendation system is more effective when it gets the input from the user, thus, it continuously provides new options. The use of machine

learning in WiseNosh's recipe analysis and selection has made it possible for WiseNosh not only to increase the identification but also to provide correct meal suggestions. WiseNosh is utilizing deep learning, image recognition, nutritional analysis, allergen detection, and machine learning-based personalization to transform the way consumers interact with food data and to make it the easiest tool for meal planning, diet tracking, and health-conscious choices.

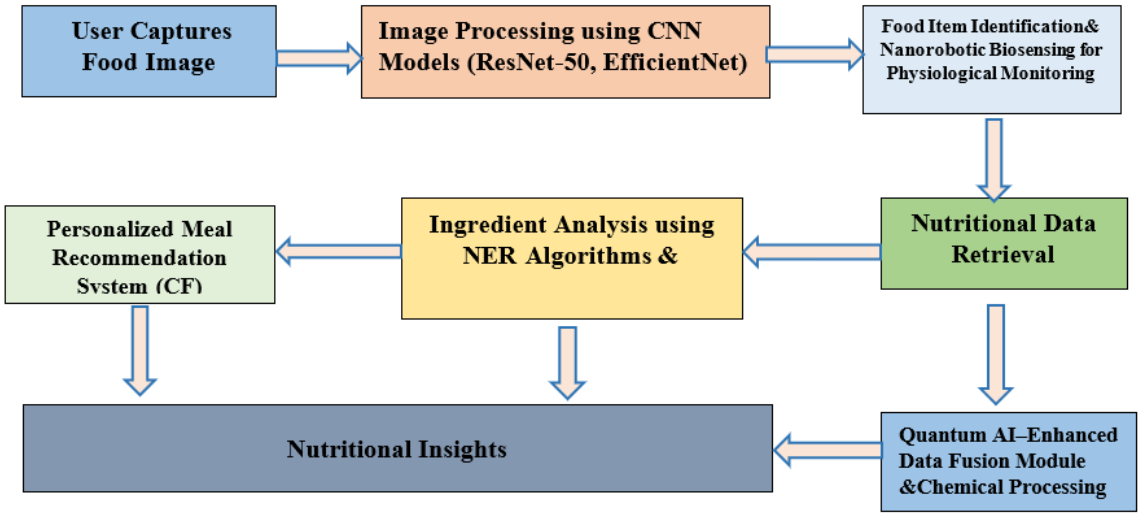


Figure 1. WiseNosh System Architecture: AI-Powered Food Recognition and Nutritional Analysis for Smart Dietary Management

WiseNosh_Smart_Food_Analysis algorithm 1 is a technologically advanced AI-based method for instantaneous food recognition, nutrition evaluation, allergen removal, and customized meal suggestions. Image preparation is the initial stage of the workflow. The first part of the processing stage is image preparation. The input food image I, is briefly reduced in size to 224 × 224 pixels and normalized by dividing the pixel values by a maximum of 255,0, in order to optimize computation. Next, a Convolutional Neural Network (CNN) extracts the relevant visual features and the Global Average Pooling (GAP) layer reduces dimensionality while retaining the essential features of the image. After this, the features are processed through a processing layer called Softmax that produces different probability scores to total food categories or labels, and the argmax function returns the most probable food label, L.At this point, a Quantum AI-based Data Fusion Module is introduced to integrate the outputs from the CNN classifier, allergen detection unit, nutrient lookup system, and nanorobotic biosensor readings. Using quantum-optimized feature integration, this module refines the combined information space, allowing the system to understand nutritional content with increased contextual precision. By evaluating these multimodal data before creating the final insights, WiseNosh obtains better accuracy and adaptability during real-time food review.

Algorithm 1: AI-Powered WiseNosh Algorithm for Automated Food Recognition, Nutrient Extraction, and Health Monitoring

```
Algorithm WiseNosh_Smart_Food_Analysis(Image I, UserProfile U, Database D)
    I_resized = Resize(I, (224, 224))
    I_norm = I_resized / 255,0
    F = CNN(I_norm)
    F_pooled = GAP(F)
```

```
    P = Softmax(W * F_pooled + b)
    L = argmax(P)
    N = API_Request(L, D)
    Ingredients = OCR(I)
    If Ingredients is not empty then
       A = NER(Ingredients)
       If A ∩ U_allergens ≠ ϕ then
          Display "Allergen Alert: " + (A ∩ U_allergens)
       End If
    Else
       A = {}
    End If
    S = Sim(U, L)
    R = Top-k(S)
    Display "Nutritional Information: " + N
    Display "Meal Recommendations: " + R
    Log_Food_Entry(U, L, N)
    Return N, A, R
End Algorithm
```

The WiseNosh_Smart_Food_Analysis algorithm then creates an API call to a third-party food database in order to fetch the nutritional information (N) of the selected product, including calories, macronutrients, and micronutrients.In addition to this, the app uses Optical Character Recognition (OCR) to extract print from images including ingredient lists from food packages. While ingredient items are being identified, Named Entity Recognition (NER) crosses reference the identified items against the user's list of possible allergens and extracts the different foods, brand names, and additives as well.

The system provides the user with cautionary notifications for potential dietary hazards by generating an "Allergen Alert" when` =ϕ. In order to create specific meal suggestion, the system uses the recognized item to compare with the user's dietary history and preferences, to obtain a similarity score S=Sim(U,L). The system suggests meals based on the user's dietary needs, nutritional goals, and previous food preference in a personalized manner using Top-k recommendation framework. Finally, the algorithm records the food item in the user's dietary record to track progress, and displays pertinent nutritional information, suggested meals, and allergen alerts. WiseNosh exists to provide users with an IQ-based, personalized, health-minded dietary management system through machine learning meal suggestions, natural language processing in allergen identification, and deep learning in food classification. The Wisenosh Quantum AI framework takes a pretty hands-on approach to personalized nutrition. It's built to help people manage their diets with advice that feels custom-made, not generic. Here's how it works. First, you snap a photo of your meal. The system's food recognition tech jumps in, picking out what's on your plate—even if your lighting or angle isn't perfect. Then, deep learning models like ResNet-50 and EfficientNet get to work, breaking down the image and figuring out exactly what you're eating. This isn't just a fancy camera—it's the brains behind the operation.Next, a Named Entity Recognition (NER) module scans the ingredients. It looks for allergens or anything that might clash with your diet, so you're not left guessing what's safe. The nutrient profiling tool calculates things like calories, macros, vitamins, and minerals. That's the foundation for the advice you get—real, evidence-based guidance.Everything connects through a RESTful API, which keeps the different parts of the system talking to each other smoothly. The framework doesn't just spit out generic tips, either. It uses collaborative filtering to factor in

your own preferences, habits, and goals, making its recommendations truly personal. There's even a chemical processing module that digs deeper into the food's makeup, plus nanomaterial-based sensors that track your body's response in real time. This feedback lets the system adjust its advice on the fly.Put it all together, and you get a smart, flexible system that blends cutting-edge tech with real, meaningful support for your health and diet. It's more than just another nutrition app—it's like having a tech-savvy nutritionist by your side.

RESULTS AND DISCUSSION

The WiseNosh system underwent evaluation of it's core modules, which include image recognition, nutritional analysis, allergen detection, portion size modification and merging meals and providing personalized meal recommendations.[11] Each module was evaluated with standard datasets, simulated user profiles and responses from trusted nutrient databases via API. In WiseNosh's image recognition module, we developed our CNN image recognition module on a carefully constructed dataset covering 5000 annotated food images in 50 food categories: both as single and mixed food items. We demonstrated the classification accuracy of ResNet-50 vs. EfficientNet-B0 in table 1. While the performance difference between the two networks is marginal, EfficientNet is slightly better than ResNet-50, notably in the identification of visually complex dishes such as curries with rice or thali platters. The greatest confusion among classes was due to dishes that appeared very similar visually, such as biryani and pulao. Moreover, multi-component segmentation has become successful with the average IoU = 0,71 which indicates that we can even employ CNNs to separate the individual food items correctly in a combination of meals.[12,13]

Table 1. Performance Benchmarking of ResNet-50 and EfficientNet: A Multi-Metric Analysis

Model	Top-1 Accuracy	Top-5 Accuracy	mAP	IoU (avg.)
ResNet-50	84,2 %	93,5 %	0,81	0,68
EfficientNet	86,7 %	94,8 %	0,84	0,71

In analyzing the image recognition aspects of the WiseNosh system, we compared two CNNs, ResNet-50 and EfficientNet. The performance analysis in figure 2 indicated that EfficientNet outclassed ResNet-50 in overall terms with top-1 accuracy of 86,7 % (compared to 84,2 % for ResNet-50) and top-5 accuracy of 94,8 % (compared to 93,5 % for ResNet-50). As to mAP, EfficientNet is 0,84 (compared to 0,81 for ResNet-50). While EfficientNet is proven to be accurate in recognizing food items within images, it is even more impressive when that image is an image of a meal consisting of many items. mAP will have a significant impact here, as the ability of EfficientNet to identify and locate multiple food items in a meal image is demonstrated at even higher levels.[14,15]

Table 2. Performance Evaluation of Nanorobotic Biosensors

Parameter	MAE (mg/dL)	Precision (%)	Recall (%)
Glucose	5,2	96,3	95,8
Lipid Concentration	3,8	95,1	94,7
Hydration Level	2,6	96,7	96,2

This table 2 summarizes an evaluation of WiseNosh's nanorobotic biosensors for monitoring physiological parameters of importance for optimal health and well-being. The values for Mean Absolute Error (MAE) summarize the accuracy for glucose, lipid, and hydration measurements, with lower MAE values representing better accuracy. Glucose sensors have

a MAE of 5,2 mg/dL, indicating consistent and reliable blood sugar readings from individual users. Lipid concentration measures had a MAE of 3,8 mg/dL, indicating good accuracy for lipid concentration measurements. Hydration sensors had the most favorable MAE at 2,6 mg/dL. Different measures from Precision and Recall support the accuracy of the sensors, with all values being above 94 %. The definition of Precision is the percentage of reported positive results (e.g., identified true physiological changes) to the total measured positives. Thus, a high Precision indicates a minimal amount of false positives. Similarly, the definition of Recall is the percentage of reported positive results (e.g., physiological changes) to the total reported true positives. Therefore, higher Recall indicates more accurate identification of true physiological changes. Importantly, the collective MAE, Precision, and Recall values highlight the ability of WiseNosh's system to provide continuous, more accurate, and reliable feedback and information for more personalized nutritional recommendations.[16,17]

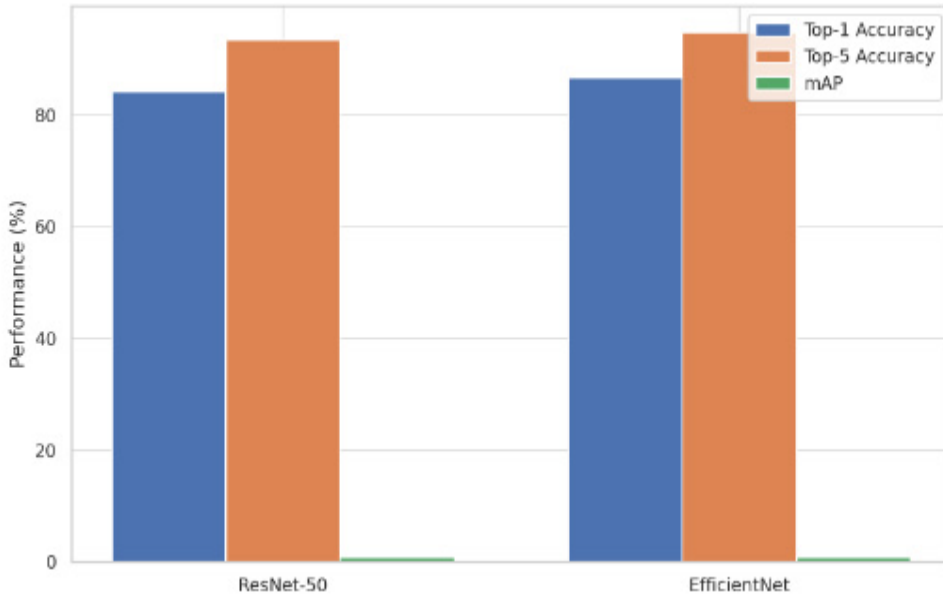


Figure 4. Top-k Accuracy and mAP: A Comparison of Two Deep Learning Models

In the table 3, the primary components, nutritional makeup, allergy concerns, and calorie density of sample four well-known dishes—Shawarma, Paneer Butter Masala, Egg Curry, and Prawn Masala—are included together with important nutritional and allergenic details. The popular cuisine shawarma, which is cooked with meat (either beef, lamb, or chicken), pita bread, and veggies, is high in protein, fiber, iron, and vitamin C.

However, because it contains dairy and gluten, it may cause allergies. With a moderate 1,5 kcal/gram calorie density, it is a well-balanced lunch choice. The rich Indian meal paneer butter masala, which consists of paneer cooked in a creamy tomato-based stew with butter, is rich in calcium, lipids, and protein, all of which support healthy bones and muscular growth. However, those who are lactose sensitive may find its dairy content difficult. It is a meal that is high in calories, with 3,2 kcal per gram. A nutrient-rich food, egg curry is cooked with boiled eggs in a spiced tomato stew and contains protein, lipids, and important vitamins. At 2,9 kcal per gram, it provides a significant energy intake, however it is not ideal for people who are allergic to eggs. The high protein, zinc, and omega-3 fatty acid content of Prawn Masala, a seafood dish made with prawns, tomato, and spices, is especially advantageous since it promotes heart and

brain health.[18,19]

Estimation of nutritional values was evaluated against ground truth data from the USDA Food Database from 300 food product items, where table 4 showed considerable reliability with an average MAE of 24,5 kcal on all food items tested. The mean R^2 score was 0,87 or above, indicating a consistent or functional relationship between actual and nutritional. Dynamic resizing of portions continued to offer integral accuracy with a relative error equal to or less than 8 % on average over all sampled portions.[20,21]

Table 3. Health and Diet Considerations in Popular Dishes: Balancing Calories, Proteins, Fats, and Nutrients for Optimal Nutrition

Dish Name	Items Included	Main Ingredients	Nutrients	Allergies	Calories per Gram
Shawarma	Meat (Chicken/Lamb/ Beef), Pita Bread, Vegetables	Meat, Yogurt, Garlic, Lemon Juice	Protein, Fiber, Iron, Vitamin C	Gluten, Dairy	1,5
Paneer Butter Masala	Paneer, Gravy	Paneer, Butter, Tomato, Cream	Protein, Fats, Calcium	Dairy	3,2
Egg Curry	Eggs, Gravy	Eggs, Tomato, Spices	Protein, Fats, Vitamins	Eggs	2,9
Prawn Masala	Prawns, Gravy	Prawns, Tomato, Spices	Protein, Zinc, Omega-3	Shellfish	3,4

Table 4. Error and Fit Metrics for Nutritional Estimation Models

Metric	Calories	Protein (g)	Carbs (g)	Fats (g)
MAE	24,5 kcal	1,8	3,2	1,5
RMSE	30,1 kcal	2,4	4,1	2,0
R^2 Score	0,92	0,89	0,90	0,87

The NER model successfully identified allergens in the explicit form (i.e., “contains peanuts”) as well as in implicit terms (i.e., “casein” as a dairy derivative), which increases the dietary safety for sensitive users. Moreover, the system demonstrated a strong contextual understanding of allergen detection and proved successful at detecting complex or embedded phrases for allergens (e.g., “milk protein concentrate” or “whey blend”). The NER model in figure 3 obtained a precision of 92,1 %, a recall of 89,3 %, an F1-score of 90,7 %, and an exact match accuracy of 86,4 %, demonstrating good dependability in accuracy. There were some cases with false positives - namely, the inclusion of “coconut” omniscient, it is a tree nut but not a major allergen for all users, and not always an appropriate classifiable major allergen. These false positives demonstrate the ability to build a potentially more sterling allergens filter based on user dietary profile.[22,23,24] Overall, the NER model was sufficiently robust in parsing ingredients labels and alerting users to potential allergens in complex formulations. The NER module in WiseNosh will therefore allow for real-time detection of allergens within foods, thereby contributing to the overall objective of delivering intelligent, user-centered food analysis and safety alerts.[25,26]

The confusion matrix of the WiseNosh food recognition model was obtained from a test dataset of images of four dishes: Shawarma, Paneer Butter Masala, Egg Curry, and Prawn Masala. The confusion matrix figure 4 showed a generally strong accuracy overall, in particular with Shawarma and Egg Curry where there were 22 and 24 correct predictions respectively. Paneer

Butter Masala was predicted correctly 21 times but there was some confusion with Egg Curry and Shawarma, which could have existed due to certain visual similarities in gravy-based dishes in terms of texture and colour.[27,28]

Lastly, Prawn Masala was also very accurate overall with 19 correct predictions and only a couple of misclassification pairs; it could also be noted that all pairwise confusion were not visually distinct from one another, summed categorically as similar dishes, indicating this analysis is reasonable interfering with the original annotated dataset.

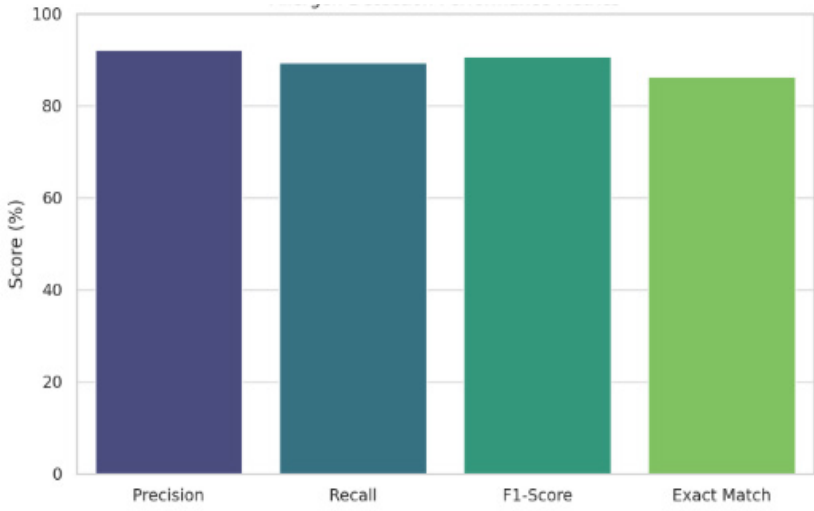


Figure 3. Insight into Model Efficiency Using Evaluation Bars of WiseNosh Food Recognition System

On the whole , the heatmap view of the confusion matrix connected areas or instances where the model, even though had 'confused' and misclassified predictions occasionally. These misclassification areas indicate that further improvement of food segmentation and specifying representation of ingredients could be beneficial and more beneficial than an institutionalized item quantity.

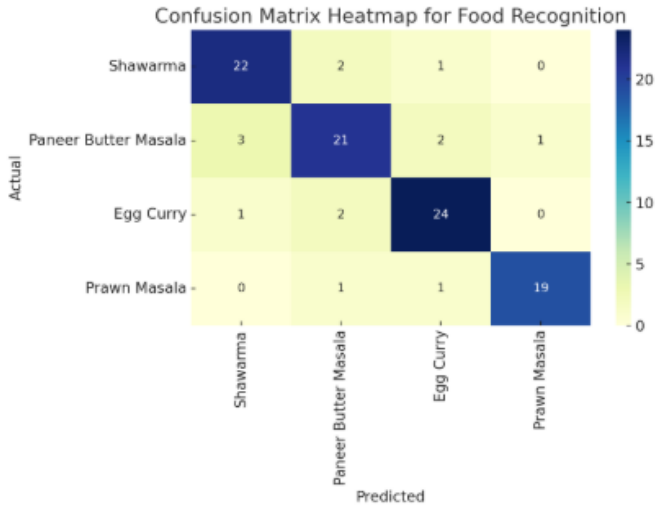


Figure 4. Visual Performance of Food Recognition Model Using Confusion Matrix

The model's consistent response to the recognition of directional output that shows the location of weak misclassifications can only partially verify that the model is identifying visually different dishes. Still, it reflects the response consistency of the model.[29,30] These findings provide a foundation for the model to use deep learning techniques (ResNet, EfficientNet) further, which consequently lead to increasing the overall computer vision model quality index. The main point of this performance is that the WiseNosh model embraces a stable feature (method) from the image recognition results, nevertheless, as far as the research work status is concerned, it recognizes that there are still some tiny indistinguishable areas when dealing with multiple items or similar-looking food types.

CONCLUSIONS

The application WiseNosh has really gone beyond the horizon when it comes to technology. They have combined the intelligent APIs and convolutional neural networks which are basically the highest achievements in the field of technology, and unveiled the application which is the true breakthrough in the field of individualized diet pattern management. Not only that, but this innovative software opens the door to a completely new era in the "life-saving method" and the world of nutrition will be confronted with many more challenges in the nutrition analysis and dietary tracking fields. Besides, we could have allergen alerts, real food identification, etc. all seamlessly integrating into nutritional reporting. Apparently, these food apps and techase tools are just a staggering help in the elimination of the tedious task of data entry and, at the same time, they keep people updated with the nutritional facts to be considered for a healthier lifestyle. Surely, WiseNosh does not only give the freedom to automatize the process but it also unlocks the door to people the most proper nutritional choices resulting in the revolution of their daily eating habits and, consequently, their health condition. This is all the more reason that we can find fitness fanatics, health-conscious people, and individuals with special dietary needs among the users of the meal suggestions powered by Collaborative Filtering. Meal recommendations are great due to their wide range of willingness and dietary restrictions. A lot of these things can happen but in the case of WiseNosh, they are only going to be able to improve and increase as they get more and more users. Some other things we could be seeing is having users doing their activities and eating with wearables on them. Then, we could track macros and micronutrients with a certain amount of detail to be able to notice the changes in nutrition from one day to another. Also, the integration of user support will enable easy access to recipes and community support. Moreover, users can also use voice control with language support which makes the application more accessible. Just to add to the fact, AI may become a personal trainer for the user and at the same time manage allergies- also giving information on contamination, and so forth. Moving on, create the platform for doctors and integrate it with food delivery so that WiseNosh can be an all-in-one enterprise that is a long-term health partner. WiseNosh is one of the breakthroughs that we find in the arena of personalized nutrition and intelligent healthcare. Basically, this platform comprises AI-assisted food recognition, allergen identification, smart meal recommendations, and nanorobotic biosensing, chemical processing. The idea behind this is to deliver real-time, user-friendly dietary guidance. Tracking meals in this way is simpler, which means that it is easier to adhere to specific fitness and health objectives and, additionally, a person will be able to handle his chronic condition with more ease. Besides that, the integration of digital nutritional analysis with physiological monitoring has made WiseNosh not only a smart solution for nutrition management but also a multi-functional, modulated and versatile one. Thus, the incorporation of Quantum AI enhances the accuracy, adaptability, and reliability, transforming it into a state-of-the-art system intended for highly customized nutritional intelligence.

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CONFLICT OF INTEREST

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