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IBM NALAIYA THIRAN PROJECT

AI-powered Nutrition Analyzer for Fitness Enthusiasts

BASED ON Artificial Intelligence

PANIMALAR ENGINEERING COLLEGE

TEAM ID: PNT2022TMID00893

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ABSTRACT :

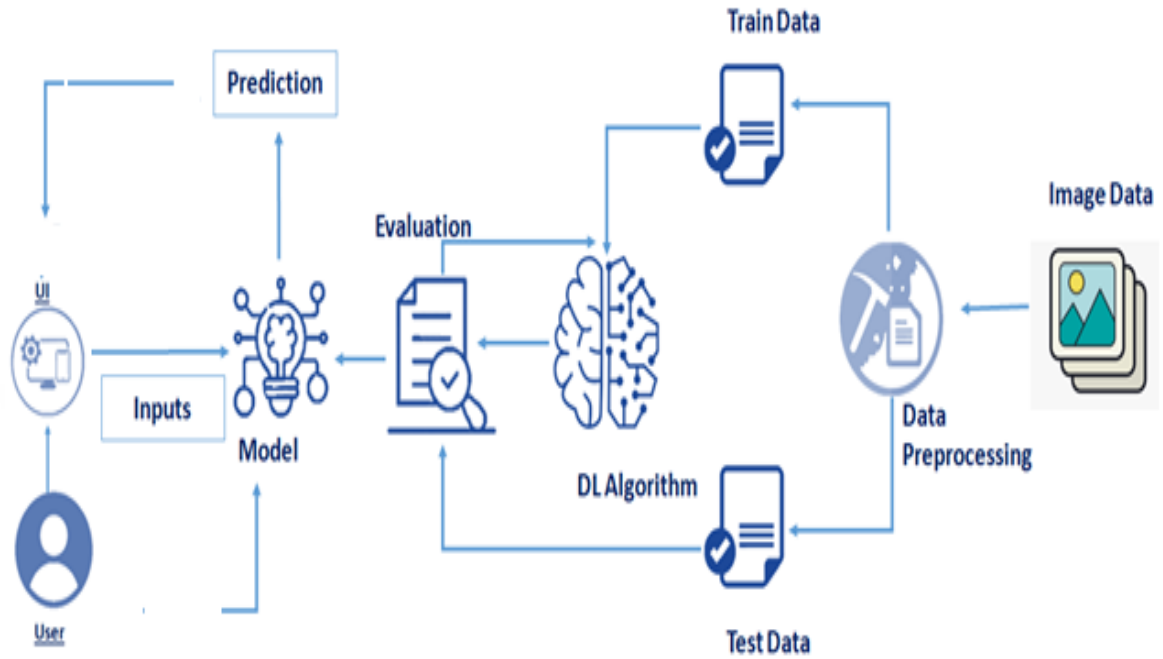
Artificial intelligence (AI) as a branch of computer science, the purpose of which is to imitate thought processes, learning abilities and knowledge management, finds more and more applications in experimental and clinical medicine. In recent decades, there has been an expansion of AI applications in biomedical sciences. The possibilities of artificial intelligence in the field of medical diagnostics, risk prediction and support of therapeutic techniques are growing rapidly. The aim of the article is to analyze the current use of AI in nutrients science research. The literature review was conducted in PubMed. A total of 399 records published between 1987 and 2020 were obtained, of which, after analyzing the titles and abstracts, 261 were rejected. In the next stages, the remaining records were analyzed using the full-text versions and, finally, 55 papers were selected. These papers were divided into three areas: AI in biomedical nutrients research, AI in clinical nutrients research and AI in nutritional epidemiology . It was found that the artificial neural network methodology was dominant in the group of research on food composition study and production of nutrients. However, machine learning algorithms were widely used in studies on the influence of nutrients on the functioning of the human body in health and disease and in studies on the gut microbiota. Deep learning algorithms prevailed in a group of research works on clinical nutrients intake. The development of dietary systems using AI technology may lead to the creation of a global network that will be able to both actively support and monitor the personalized supply of nutrients. Nutritional intake is fundamental to human growth and health, and the intake of different types of nutrients and micronutrients can affect health. The content of the diet affects the occurrence of disease, with the incidence of many diseases increasing each year while the age group at which they occur is gradually decreasing. An artificial intelligence model for precision nutritional analysis allows the user to enter the name and

serving size of a dish to assess a total of 24 nutrients. A total of two AI models, including semantic and nutritional analysis models, were integrated into the Precision Nutritional Analysis. A total of five different algorithms were used to identify the most similar recipes and to determine differences in text using cosine similarity. This study developed two models to form a precision nutrient analysis model. The Taiwan National Nutrition Health Status Change Survey was used for model verification. The model's accuracy was determined by comparing the results of the model with the NNHS. The results show that the AI model has very little error and can significantly improve the efficiency of the analysis. This study proposed an Intelligence Precision Nutrient Analysis Model based on a digital data collection framework, where the nutrient intake was analyzed by entering dietary recall data. The AI model can be used as a reference for nutrition surveys and personal nutrition analysis.

INTRODUCTION :

Nutritional intake is the basis for human growth and health, and the intake of different types of nutrients and micronutrients can affect health. Most diseases are inextricably linked to diet. Diabetes, cardiovascular diseases (hypertension, hyperlipidemia), gout, peptic ulcers, and gastroenteritis are all diet-related diseases that are increasing in prevalence every year, while the age group of those suffering from these diseases is gradually decreasing . ANNs (Artificial Neural Networks) as a currently widely used modeling technique in the field of AI were inspired by the structure of natural neurons of the human brain. There are three types of layers forming ANNs. The input layer captures the raw data and passes them to the hidden layer. In this second layer, the learning process takes place. The results of the analysis are collected in the output layer and the output data are created. A neural network may consist of hundreds of single units. An ANN is a parameterized system that has weights as adjustable parameters. Due to the need for estimation of these parameters, ANNs require large training sets. ANNs acquire knowledge by detecting patterns and relationships between data, i.e., through experience, not as a result of programming. An ANN reveals its particular usefulness in the case of the need for modeling datasets with non-linear dependencies. In solving biomedical problems, raw data can be both literature and experimental data. In the last two decades, ANNs have been used, among others, to create an experimental decision algorithm model open to improvement, aimed at evaluating the results of biochemical tests confronted with both reference values and clinical data. This technique was also used in evaluation of cell culture cross-contamination levels based on mass spectrometric fingerprints of intact mammalian cells. The particular usefulness of ANNs has been proven in pharmaceutical analyses . An interesting application of ANNs is the prediction of the relationship between the Mediterranean dietary pattern, clinical characteristics and cognitive functions .

The usefulness of ANNs has been proven in body composition analyses, which have clearly non-linear characteristics . Using ANN modeling, significant benefits can be obtained in clinical dietetics. It is worth noting that the fuzzy logic methodology (FLM) can be combined with neural networks. The idea of this area of AI is to strive for greater accuracy, dimensionality and simplification of the structure. There is a possibility to create fuzzy neural networks and convert FLM-based models into neural networks.



Materials and Methods:

This study developed an AI model based on semantic text to analyze the nutritional ingredients of a nutrient, and a digital data semantic analysis model was designed to determine the names and servings of the dishes consumed. The AI model is based on the ingredients of common Taiwanese recipes and automatically calculates the nutrient intake. The model structure consists of a digital data semantic analysis model, an AI precision nutrient analysis model, a database of 1590 recipes, and 7869 ingredients from common Taiwanese recipe databases, and the model structure is shown in Figure 1. The nutrition information of the ingredients was obtained from the public data of the Health Promotion Administration, Ministry of Health and Welfare Taiwan (HPA, MoHW).

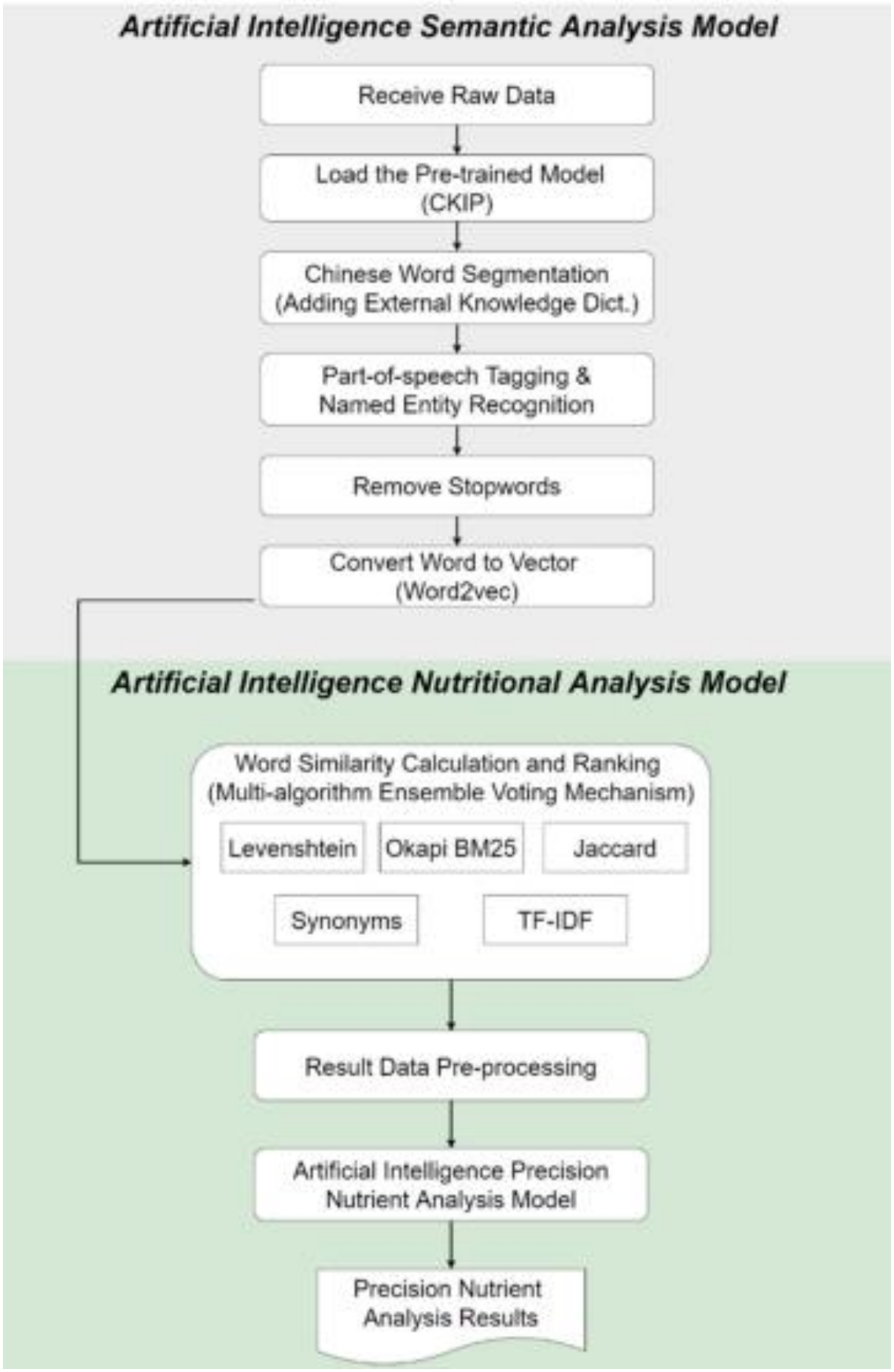
Artificial Intelligence Semantic Analysis Model

Data were intercepted and annotated after data entry, and a CKIP pretraining model was used to interpret Chinese words. After completion, lexical annotation and entity identification were performed. Finally, the nouns (dish names) were converted into vector structures using word2vec, which is an application of Natural Language Processing proposed by Tomas Mikolov et al. at Google in 2013 and is one of the most significant advances in the field of machine learning in recent years. Word2vec is an application framework that learns large amounts of textual data and transforms words into mathematical vectors to discriminate their semantic meanings by embedding words into a two-dimensional space in order that words with similar semantic meanings can be closer together. This study used the continuous bag-of-words (CBOW) method, which aims to determine the lexical properties of the input words using a whole paragraph of context and to determine the relationship between similar

words by concatenating them. As similar words are clustered together, the direction of the vector corresponds to the relative relationship.

Artificial Intelligence Nutritional Analysis Model

The Nutritional Analysis Model is divided into three steps. Step 1 conducts artificial intelligence analysis to determine the most similar recipes. Due to the multicharacter nature of Chinese, single algorithm of semantic analysis may not be precise enough. Therefore, a variety of algorithms were used for the analysis. The AI model is composed of five different algorithms, including 1. Okapi BM25, 2. TF-IDF, 3. Levenshtein, 4. Jaccard, and 5. Synonyms. The algorithm also uses cosine similarity to determine differences in text and then compares it with a database to obtain food information and portion sizes for recipes and ingredient judgement. Step 2 is to determine the best solution by the common voting mechanism


Artificial Intelligence Semantic Analysis Model
Receive Raw Data
Load the Pre-trained Model (CKIP)
Chinese Word Segmentation (Adding External Knowledge Dict.)
Part-of-speech Tagging & Named Entity Recognition
Remove Stopwords
Convert Word to Vector (Word2vec)
Artificial Intelligence Nutritional Analysis Model
Word Similarity Calculation and Ranking (Multi-algorithm Ensemble Voting Mechanism)
Levenshtein
Okapi BM25
Jaccard
Synonyms
TF-IDF
Result Data Pre-processing
Artificial Intelligence Precision Nutrient Analysis Model
Precision Nutrient Analysis Results

How to make artificially intelligent food choices:

The Day Two app uses an **algorithm based on research** when they used their algorithm to match a diet to an individual's microbiome and metabolism, it was **better at controlling blood sugar** than the Mediterranean diet, considered **one of the healthiest in the world.** This technology is relatively new and only relates to blood sugar. The Mediterranean diet, meanwhile, has decades of research behind it and will likely remain the gold standard for healthy eating for years to come. Still, for people like A.I. like Day Two's can make it easier to maintain healthy eating patterns. The app's machine-learning algorithm can identify patterns and learn from data with human help. It analyzes data from different individuals' blood sugar responses to tens of thousands of different meals to identify personal characteristics — age, gender, weight, microbiome profile and various metabolic measurements — that explain why one person's glucose spikes with certain foods when another person's doesn't. The algorithm uses these observations to predict how a particular food will affect one's blood sugar and assign each meal a score. which is currently only available to employers or health plans, not consumers, is one of a handful of A.I.-based apps recommending healthier meal options. also generates meal scores and is available directly to consumers for per month. algorithm uses additional data, **such as blood fat levels**, in addition to microbiome and blood sugar tests. The algorithm was able to predict how a person's blood sugar and fats respond to different foods Currently these algorithms mostly focus on blood sugar, but newer versions will incorporate more personal data, and, in theory, recommend diets that reduce cholesterol, blood pressure, resting heart rate or any other measurable clinical indicator.

"Bringing in all these different data types is very, very powerful, and that's where machine learning kicks in,"

ANALYZER RESULT :

This study developed two models to form a precision nutrient analysis model. The first model is a Digitized Data Semantic Analysis Model for dish analysis and portion size determination. The second model is a Nutrient Analysis Model that uses five different algorithms to find precision recipes, which conducts analyses of dish ingredients and nutrients using a common voting process, and the final outputs from both models calculate the intake of 24 common nutrients. The operational framework of the model is illustrated below. The recipe database contains 1590 recipes and nutrient information for 7869 ingredients.

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